GAS JOURNAL

LIGHT ⁘ HEAT ⁘ POWER ⁘ BYE-PRODUCTS

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VOL. CLXXXVI. No. 3438.] WEDNESDAY, APRIL 10, 1929 [81ST YEAR.

Editorial Notes.

Report on the Holborn Explosions.

HAVING regard to the fact that they sat for fourteen days and heard evidence from 73 persons, there has been no undue delay in the issue of the report of the Home Office Commission of Inquiry into the explosions and fires which caused so much material damage in the neighbourhood of New Oxford Street, Holborn, on Dec. 20 and 21 last. Neither was any time lost in the setting-up of the Commission, to constitute which Mr. R. J. Hetherington, O.B.E. (Chairman), Lieut.-Col. R. A. Thomas, C.B.E., and Mr. E. H. Tabor were appointed by the Home Secretary on the evening of Dec. 21. Beyond inquiring into the circumstances of the series of explosions and fires, their warrant of appointment placed upon the Commissioners the duty of adding any observations or recommendations which they might think right to make "with a view to minimizing risks to life and property in the future." In addition to the public sittings, there were many private meetings, and valuable visits, details of which appear in the report. One notes the conviction of the Commissioners that not only has no relevant information been withheld, but that all parties desired to place before them, as soon as it came into their possession, any information relating to the investigation. This was essential to a full inquiry, and was no more than was to be expected of the Gas Light and Coke Company and the General Post Office, who were the parties principally concerned. Throughout, the Commissioners had the advantage of the advice of Prof. R. V. Wheeler, Director of Research of the Safety in Mines Research Board, whose services were placed at their disposal by the Mines Department.

Going through the narrative of events as set forth in the report, we are also pleased to see the reference in the following terms to the measures taken to deal with the emergency, though this again is just what might have been expected of an undertaking so well organized as the Gas Light and Coke Company.

We desire at this point to express our admiration of the manner in which the emergency was dealt with. The situation was without precedent, and there is no doubt that there was considerable danger to life and property from the large escapes of gas coming from broken mains along the line of the explosion. It is clear from the evidence that prompt and effective measures were taken by everyone concerned to deal with the situation. The brunt of the work naturally fell on the officers of the Gas Company. They very wisely decided that it would be dangerous to attempt to cut off the supply of gas from the area, and that the proper course was to take measures to ascertain where the fractures had occurred and to isolate the lengths of main concerned. Steps for this purpose were taken without delay; and we think it is highly probable that, but for the skill and promptitude of the officers of the Gas Company, and the efficiency of the organization at their command, there might have been a much more serious calamity. Mr. Doig Gibb described the measures taken as being beyond all praise, and we concur in this view.

Question of Ventilation.

THE Commissioners find that the explosion occurred in a subway constructed by a private Company nearly seventy years ago, and in a section extending from Kingsway to St. Giles' Circus, the desirability of ventilating which was recognized by the Corporation of the City of London and the Borough Councils of Holborn and St. Pancras ten years before the subway came into the hands of the Post Office. The Corporation and Councils constructed ventilators at a number of points along the subway; one of them—"a hole 2 ft. in diameter"—being in the section with which the inquiry was concerned. When subsequently the Post Office acquired the subway, they "constructed manhole chambers of their standard type, as and when they were required, and provided duct and pipe lines to connect the tube with other portions of the underground telephone system. In the course of this work the ventilator constructed by the Holborn Borough Council in 1910 (which was situated at a point near the eastern entrance to St. Giles' Church) was removed, in accordance with the standard practice of the Post Office, which is to use unventilated covers in order to prevent the entry of water and dirt."

The subway then, in fact, "became an integral part of an extensive underground system, with which it was connected at several points by a large number of pipes or ducts, some of which were empty. The pipes and ducts, except in so far as they were occupied by cables, had open ends, but where they led into a London County Council subway, as for example at Kingsway, they were plugged. Whether plugged or not, they were arteries in the main Post Office telephone system."

This was the position of affairs at the time of the explosion; and subsequent events were to demonstrate the necessity of free ventilation of underground structures in which it may be otherwise possible for explosive mixtures to accumulate. In the forefront of the lessons to be learned from the occurrences into which the Commissioners inquired, must surely be placed this one.

Explosive Agent and Cause of Ignition.

BY a process of elimination, the Commissioners are left with coal gas as the explosive agent; and this theory they feel is consistent with all the facts. They, therefore, after carefully weighing the evidence, are able with confidence to say that the explosion was due to a mixture of coal gas and air. While it has been quite impossible to trace with certainty the precise source of the gas, the Commissioners incline to the view that it was present as the result of a gradual accumulation, reinforced probably by an escape within a short time of the explosion. The ignition, they are satisfied, occurred in the Post Office manhole, within a very short time after one of their employees (a man named Thrower, who received injuries from which

he subsequently died) had descended to the subway to start a blower, which had been provided consequent upon men having been overcome by gas or foul air. Thrower went into the subway from the manhole for the purpose of attaching the lead from the blower to the socket; and as soon as he had disappeared into the subway, a flame appeared.

During the inquiry three of the employees of the Charing Cross Electric Supply Company came forward, and said they had heard conversation as to the use of a pocket lighter by Thrower; and the result of the statements of these men was to bring forth evidence of the finding of a lighter near the manhole at which the explosion originated. The Commissioners think it probable that Thrower did use a lighter to enable him to find the socket; but if no evidence as to a lighter had been submitted to them, they would "still have come to the conclusion that the ignition of the gas was caused by some action on the part of one of the three Post Office workmen—probably Thrower." The fact that the socket (originally used for lighting purposes) had not, when the blower was provided, been removed to a position in which it could have been reached from the ground level, must, in the opinion of the Commissioners, be regarded as a contributory cause of the explosion; "but it cannot be said that, if it had been altered, the explosion would not have taken place."

So far we have contented ourselves mainly with stating the findings of the Commissioners. Inasmuch as they emphasized from the outset the fact that they were in no way engaged in settling the question of legal liability, the matter must presumably be regarded as remaining *sub judice*.

Recommendations and Observations of the Commissioners.

As readers of the "Journal"—who through our columns were kept in close touch with every phase of the inquiry—are aware, the Post Office urged that it is safer to allow gas to accumulate in an underground chamber, so that its release can be controlled, than to allow it to escape by a system of continuous ventilation. The Commissioners hold the opinion, however, that the latter method is the wiser. All manholes, they recommend, should have constant ventilation, the provision of which would not involve unreasonable expenditure in view of the additional safety thereby obtained; and they urge that the whole of the tube under review should be examined immediately, and that continuous ventilation should be installed where it does not at present exist. With regard to gas leakage, the suggestion is made that the employment of some form of continuous detector would provide an additional safeguard. An apparatus of this nature, it will be recalled, was illustrated and described in the "Journal" for Jan. 30, p. 273. Discussing the methods of the Gas Light and Coke Company for dealing with leakages, the Commissioners, while praising highly the Company's organization for promptly repairing leakages when discovered, think that the collection of information as to leakage is treated too much as a matter of routine, and may in the ordinary way sometimes fail to be brought to the consideration of "sufficiently responsible officials who are in a position to appreciate the full significance of all the facts." They are of opinion, therefore, that the Company ought to strengthen their organization to make it the primary duty of some responsible officer to control the work of leakage detection.

The question of subways is discussed at some length; the general views of the witnesses at the inquiry being outlined. No conclusions are set out in the report, which, however, indicates that subways are unsuitable for high-tension electric mains, and that it is preferable that gas mains should be laid in the ground. The statement of Mr. Doig Gibb is quoted—that electric cables and gas mains would never live at peace in the same conduit. As for the depth at which gas mains should be laid, this, the Commissioners suggest, is a matter which would well repay detailed investigation, particularly in view of the fact that difference of opinion exists as to how far modern traffic conditions have increased the vibration passing through the ground. A further question which ought to receive careful consideration, state the Commissioners, is the possibility of closer co-operation in the control of underground services. This, we are of opinion, would be in the interests of all concerned. In this connection, the report suggests that it might be advantageous to set up without delay some body to collate information and, when opportunity presents itself, to simplify the disposition of existing mains.

Coke Oven Gas for Town Use.

It is nearly twelve years since the Sheffield Gas Company commenced the purchase of coke oven gas in bulk. At that time the quantity they bought daily amounted to 1½ million c.ft. To-day the figure is 13 millions—which fact, bearing in mind the low price of the gas supplied by the Company—provides adequate proof that in favourable circumstances it is a wise commercial proposition for a gas undertaking to act partially as a distributor, as distinct from an actual manufacturer, of town gas. The latest supply—some 4 million c.ft. a day—is from the Nunnery Colliery Company, and the terms of the contract constitute what will, we think, be generally agreed to be the most equitable basis, alike to supplier and purchaser, for any arrangement of the kind yet made. It is guaranteed, among other things, that the calorific value of the gas delivered shall not be less than 520 B.Th.U. per c.ft., that the gas shall be pumped through the mains uniformly throughout the day; that it shall contain not more than 0·5 p.ct. of oxygen nor more than 800 grains of sulphuretted hydrogen per 100 c.ft; that the naphthalene content shall not exceed 2 grains per 100 c.ft. or the nitrogen 9 p.ct.; that the suppliers shall provide and maintain boosting plant and adequate storage, and in addition a supply of coal to cover emergencies; and that the price of 0½d. per 1000 c.ft. shall be subject to a sliding-scale dependent on the basic price of coal.

In view of the foregoing, our readers will be interested in a description of the plant, employed by the Nunnery Colliery Company, which is capable of producing coke oven gas of such a quality as to meet all these stringent requirements. This description appears on later pages of our issue to-day; and there is added interest in that it relates to a plant—the Becker—which is the first of the system to be brought into operation in this country. This, however, in no way implies that there is an element of risk in its introduction, for it has become extremely popular in America. Last year nearly 83 million tons of coal was carbonized in the United States (incidentally showing a marked increase over 1927); and of that quantity, over 20 p.ct. was treated in Becker ovens. The system was first put to work in 1923; to-day Becker oven plants in various parts of the world are either in operation or construction capable of carbonizing over 30 million tons of coal per annum—nearly as much coal as is dealt with annually in all the gas-works and coke ovens in Great Britain. The installation of the Nunnery Colliery Company which we describe to-day is not for long to remain the only one of its kind in this country, for two similar installations of Becker coke ovens are at present in course of erection. The first of these is for Thorncliffe Coal Distillation, Ltd., at Sheffield, with a carbonizing capacity of 1200 tons of coal per day, and the second for British Benzol and Coal Distillation, Ltd., at Bedwas, with a carbonizing capacity of 660 tons of coal per day.

The plant at the Handsworth Works of the Nunnery Colliery Company—which each week is now producing 2800 tons of coke, 50 tons of sulphate of ammonia, 36,000 gallons of tar, and 13,600 gallons of crude benzole, and is delivering to the Sheffield Gas Company 27 million c.ft of gas—has several important features, included among which may be mentioned ovens of larger capacity, quicker coking times, and more economical heating arrangements. The article explains how these developments have been accomplished; and they are admirably expressed by a comparative table of the Becker installation and of the old ovens which the new plant replaced. As for the gas available for sale, this amounts to 38 therms per ton of coal carbonized, and it is characterized by its high calorific value (550 B.Th.U. per c.ft.) and its low content of inerts (a nitrogen content of only 3½ p.ct. in the crude

gas collecting main). The coke made amounts to over 15 cwt. per ton, the breeze content being less than 5 p.ct., and the proportion above 2 in. being over half the total quantity. The coal and coke handling arrangements are excellent, and altogether the installation, which includes efficient plant for benzole recovery and for ammonia recovery by the semi-direct process, reflects the greatest credit on the Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., who were responsible for its design and construction and for its operation in the initial stages. There are many striking points about this installation—one being the high benzole recovery, and another the small space occupied by the carbonizing unit in relation to its capacity.

The Real Danger.

When referring in last week's issue of the "Journal" to the proposal of the President of the Board of Trade to appoint a "small, but experienced, Committee" to consider the question of gas poisoning, we contrasted the figures for 1927—when the number of suicides by gas reached the astonishing total of 943, and the other deaths from gas poisoning (including doubtful cases, which may have been either accidental or deliberate) numbered no more than 150—with the annual "toll of the road." This was done with the view of presenting the matter in its correct proportions. Much time and money are spent in reducing to a minimum the chances of accidental gas poisoning; and considering how universal is the use of gas, success in this direction is indicated by the figure of 150 deaths in one year—including those arising from pure accident, from faulty fittings, from gross negligence, and the ones in which the circumstances have been suspicious, but not sufficiently so to warrant a verdict of suicide. Yet the Water Gas Committee of 1898 and the Departmental Committee on Carbon Monoxide of 1921 are to be followed by another Committee whose duty it will be to consider the effects of the freedom from limitation of the proportion of carbon monoxide in gas.

We are here looking at the matter particularly from the point of view of the deaths classed as "accidental." The large number of suicides must be primarily a social problem, to be attacked, like other social problems, at its roots. But if the suicides be included, so as to bring the number of deaths to 1100, or even the figure of 1142 (presumably for 1928) quoted by Mr. Bowerman in his question in the House of Commons, how small is the total compared with the street accidents caused by vehicles. The official statistics in this connection for 1928 have been issued since our last article was written, and they show the figures then quoted in the "Journal" to have been less than the truth in the case of fatalities. In Great Britain the total of accidents to mechanically propelled vehicles has risen from 105,463 in 1927 to 117,994 last year. In this number, 49,208 were accidents to motor-cars and taxicabs, 37,450 to motor-cycles, 8340 to omnibuses and coaches, and 6018 to electric tramcars and trolley omnibuses. The number killed in these accidents was 5489, or 770 more than in the previous year. Those injured made a total of 133,431, an increase of 14,996. For every class of mechanically-driven vehicle the total of accidents has grown.

No one who studies the reports appearing in the Press can doubt that many of the accidents would be prevented by reasonable care; yet at present it seems impossible to compel the exercise of this. Can nothing be done to lessen this appalling, and growing, casualty list? This is a question to which the community is anxiously awaiting a satisfactory reply.

Optional Four-Part Tariff at Brighouse.

Mr. Charles R. Ingham, the Engineer and Manager of the Brighouse Gas Department, has introduced an optional four-part tariff for consumers of gas used for industrial and trade purposes. In the first place there is a customer charge (per meter) of 15s. 6d. per annum; there is an hourly demand charge, per 100 c.ft. of maximum hourly demand, of £1 11s. per annum; and there is a daily demand charge, also per 100 c.ft. of maximum daily demand, of 9s. per annum. Then the commodity charge for all gas consumed is 1s. 8d. per 1000 c.ft., which is equivalent to 4d. per therm. All these figures are subject to a settlement discount of 10 p.ct. The tariff came into operation on April 1; and it will be interesting to learn, after a year's working, of its effect on the development of industrial gas business in Brighouse.

Purchase of Coal on a Scientific Basis.

This question was discussed recently by Prof. W. H. McMillan, Head of the Mining Department in the University College of Nottingham, before the Nottingham Society of Engineers. Indifference to the purchase of coal on a scientific basis, he suggested, may in part be due to the fact that until recently chemists have had considerable difficulty in determining the composition of the variety of substances termed "coal;" and there is the difficulty of devising satisfactory methods of sampling. The greatest objection to the system of scientific selling, however, probably lies in the fact that in many instances in this country in the past proposed contracts have been one-sided—they have been drawn up with the idea of benefiting the consumer only. It is obvious that, when dealing with a raw material like coal, which is subject to variations even when the greatest care is taken to exclude impurities, the basis of agreement must permit of a certain amount of elasticity. Moisture and ash are the two most difficult points to deal with satisfactorily.

Local Authorities and Road Tar.

The Clackmannan County Council are, as far as we are aware, the only local authority in Scotland to specify foreign bitumen for their road requirements over the ensuing season. This was the subject of a question raised by Mr. T. Kennedy in the House of Commons recently. He asked the Minister of Transport whether it is the policy of the Ministry of Transport to make grants from the Road Fund to local authorities who do not even invite quotations for British tar. Col. Ashley replied that he is not disposed unduly to hamper the discretion of local authorities in this respect, but that where British supplies are available, it is his policy that British firms should be given an opportunity of tendering. He suggested that the requirements of the Clackmannan County Council are peculiar; but it is difficult for us to appreciate how greatly these requirements differ from those of the adjoining Counties of Stirling, Perth, Kinross, and Fife, all of whom use large quantities of British tar for road purposes, with highly satisfactory results.

Eliminating Competition at Colchester.

To the list of those iron-handed Councils who build houses, own electricity generating stations, and refuse their tenants' applications for gas lighting, must be added the Town Council of Colchester. They do not believe that tenants of their houses should be able to exercise choice between gas and electricity for illumination, albeit they seemingly place no restrictions on the use of smoke-emitting oil lamps, which is singularly illogical when it is borne in mind that the Colchester Gas Company are willing to instal the necessary pipes and to supply the fittings without any charge to the Council. Obviously the latter body, conveniently dismissing the fact that the Company are large ratepayers, have little faith that "there is room for both," and little sympathy with just competition. In an appeal which we trust will not fall upon deaf ears, the Colchester Gas Company point out—as we have stated many times in the "Journal"—that people of moderate means value gas lighting for several reasons, among others the quality and reliability of the light, its economy, and the fact that this source of illumination also provides heat which is very welcome—particularly in casual rooms. The Colchester Town Council have curtailed the liberty of the individual and have neatly eliminated gas lighting competition; but the basis of this elimination is unsound, and we have sufficient optimism to think that the inevitable repercussion will arrive. In our columns to-day we publish the letter which the Company have addressed to each member of the Council.

THE LATE MR. CHARLES HUNT.

The Funeral.

At Shirley Church, Addiscombe, the funeral of the late Mr. Charles Hunt took place on Wednesday last amid demonstrations of sincere regret and affectionate regard. The chief mourners were his sons, Mr. Clifford Holmes Hunt and Mr. Ernest Hunt; and there were noticed at the service Dr. Charles Carpenter; Mr. John Terrace, President, and Mr. James W. Campbell, Secretary, of the Institution of Gas Engineers; Dr. H. G. Colman; Mr. B. A. Parkinson; Mr. Henry King Hiller; Mr. Walter T. Dunn; Mr. Henry Kearns; Mr. F. R. Smith; Mr. Wilfrid Wastell; Mr. Clifford A. King; and others. There were numerous floral tokens from the various companies and societies with which Mr. Hunt had been so long and honourably associated.

Appreciations.

Dr. Charles Carpenter, C.B.E.,

President of the South Metropolitan Gas Company and Chairman of the South Suburban Gas Company.

I believe it was Steerforth in "David Copperfield" who asked that after death he might be thought of "at his best." It is, however, only possible to do so intelligently when one has had acquaintance or friendship with the person concerned; and in the case of the late Charles Hunt, not far off a nonagenarian at his death, there are few of the present generation so qualified. I should set down his "best" years as those he spent at Birmingham, first in the service of the Company, and then of the Corporation, supplying gas to that important city. Certainly no one could have been temperamentally better fitted than he was to collaborate with the late Joseph Chamberlain in the purchase and municipalization of the gas undertaking which played a not unimportant part in laying the foundation of that astute statesman's career. Eventually the works at Windsor Street became the Mecca of many gas pilgrims from various parts of the country, who were sure of seeing there something new, and, perhaps, startling.

Hunt was early in the field at the time of the great change-over from the direct to gaseous firing of retort settings, and he certainly had his share of the troubles entailed during the fairly long period occupied by technicians in mastering its principles. The age was one when solid progress in gas technology was being made simultaneously with curious examples of beliefs in, I had almost said, magic. Could air be heated or not? Did oxygen absorbed by baryta and subsequently displaced act, when admitted to a purifier, differently from that contained in the atmosphere? Hunt never made mistakes of this kind; and in this I think we may learn one of the lessons of his career, for he was one of those who always realized that technology must have a foundation of scientific knowledge. He could not have learned this from Robert Morton, good engineer though the latter was, during the six years he spent at Nine Elms, but there was on the staff there an able chemist in the person of Greville Williams, F.R.S.; and I suspect it was he whose influence inspired Hunt's attitude towards scientific matters which was always to be characteristic of him in after-life. He was, for example, one of those who saw very clearly the falsity of evaluing the illuminating power of town gas by burning in the London burner at the five-feet rate; and the proposal he so persistently urged of testing with the "chimney full of flame" had much to recommend it as a way out of the difficulty.

Another characteristic habit Hunt had was that of a certain originality of outlook. A number of inquirers had laid down the principle that inclined retorts should be no longer than 15 ft. Hunt asked himself "Why not 25 ft.?" Or that they should be set at an angle of 32°; and he posed the question "What is wrong with 40°?" Such a habit of thought is a simple one to practise, and may be often very useful; I think it was to Hunt. He was an acute critic and a skilful debater, and certainly loved his profession, which he practised in the good old-fashioned way, preparing with the aid of his officials his own designs and estimates. He would have been the very last man to put his name to a set of contractor's drawings and call them his own.

In him there passes away the last of the notable gas engineers of the Victorian age; and in those days truly "there were giants in the land."

E. B. Tomlinson,

Engineer of the Nechells Gas-Works, Birmingham.

It was with the greatest regret that officials of the Birmingham Gas Department heard of the death of Mr. Charles Hunt, their old esteemed Engineer and colleague. Though it is over a quarter of a century since he retired from the Engineership of the Windsor Street and Adderley Street Works, he is still kindly remembered by all those who were associated with him.

Charles Hunt was a man of such outstanding ability that, despite the lapse of time since retirement, he is considered one of the most prominent men in the history of the Department. He was held in the highest regard by his staff. They saw in him a man whose dealings were always marked with justice and firmness, and who was ever ready to give kindly advice and assistance. He showed the keenest interest in any social or philanthropic movement connected with the works, and was deeply respected by the workmen, who freely recognized the great care he exercised in decisions affecting their conditions of employment. Discipline was lacking and drunkenness was not uncommon when he came to Windsor Street; and it was not easy to regain control. Firmness and tact were required, and Mr. Hunt, with patience and dignified forbearance, soon raised the general tone.

He possessed a calm dignity, and had complete control of himself, and, therefore, of others. He was never known to lose his temper, while his serenity of demeanour was remarkable. How well I remember on one occasion when a letter had been received which was, to say the least, insulting, he quietly paced his office and the only remark heard was, "Let not him that putteth on his armour boast as he that taketh it off." Nevertheless, he was a born fighter, and would strongly resist any who opposed him. His opponents, however, were always impressed with the justice of his position.

His tireless energy and determination enabled him to surmount obstacles, whether in management or construction. His designs of gas-works plant were considered to be far ahead of the practice of those days; and the manner in which he overcame—one might almost say exploited—the natural difficulties at Windsor Street was the admiration of his many friends in the industry. He encountered innumerable difficulties in the reconstruction of the works. To erect retort houses and gasholders on such treacherous ground would have severely tested most engineers; but these only provided further opportunities for displaying the courage and ability which eventually established his name as one of the foremost in the profession.

In spite of his work and problems in Birmingham, Mr. Hunt was always willing and anxious to do anything for the advancement of the gas industry, whether by reading papers before the Institution or kindred associations, or by considered advice to brother engineers. His assistance and counsel were often sought in connection with the promotion of Bills in Parliament.

One feels that, though the loss to many of us is largely personal, the industry as a whole has been deprived of a man who will never be replaced.

Wilfrid Wastell,

Commercial Manager and Secretary of the South Suburban Gas Company.

It is a little more than forty years ago since I entered the office of the late Mr. Henry Hack at the Saltley Gas-Works of the Birmingham Corporation; and though I did not come into personal touch with Mr. Charles Hunt until long after that, I learned a great deal about his attributes from the daily correspondence which passed between the two Engineers. In those young days I used frequently to pass near the twin gasholders which he erected at the Windsor Street Works, and looked up at them with the same feeling of awe that strikes a schoolboy when, in a railway station, he contemplates a monster locomotive with steam up ready to start on a long journey to the far end of the country. It was then that I came to the conclusion that a man who could achieve so great a thing must be outstanding among his fellows.

It was not, however, until I had the privilege and honour of serving under him as Secretary of the South Suburban Gas Company that I realized how accurate was my boyish conception of Mr. Hunt. A man of culture with a decided literary bent, quick in grasping essentials, indefatigable in his work, shrewd and cogent in negotiation, he was richly endowed with the attributes which make an administrator; and with his death we must regretfully realize that one of those great pioneers who laid the foundations of the gas industry as we know it to-day has passed from among us.

Edward A. Harman.

Half-a-century's acquaintance must be my plea in asking you to allow me to pay a tribute of deep respect and esteem to the memory of Charles Hunt.

During my thirteen years' engagement with the Birmingham Corporation Gas Department, I can testify that he was at all times a perfect gentleman—considerate and kind in all his actions. He was deeply respected—one might almost say be-

loved—by the whole of the official staff and the workmen alike. Personally I am indebted to Mr. Hunt for many kindnesses.

Withal he was the soul of honour and uprightness, and his noble example may possibly have helped in causing Birmingham to be spoken of as the best governed city in the world.

For me to speak of his high qualifications as an engineer would be impertinent.

He has gone to his rest and reward after a strenuous life of duty, leaving his work as his monument.

PERSONAL.

Mr. IVOR THOMAS, an Assistant at the Neath Gas-Works, has been appointed Superintendent of the Avon Street Works of the Bristol Gas Company. Mr. Thomas, who is only 27 years of age, was educated at the Gnoll Schools, Neath, and the Swansea Grammar School. He afterwards became articled to Mr. W. Clark Jackson, the Engineer and Manager of the Neath Corporation Gas Department. At a recent meeting of the Wales and Monmouthshire Junior Gas Association Mr. Thomas delivered a paper on his practical experiences of vertical retorts.

OBITUARY.

It is with regret that we have to announce the death of Miss EDNA PENROSE MILBOURNE, only daughter of Mr. and Mrs. R. J. Milbourne, of Lilleshall, which took place on Monday, April 1, at the early age of twenty. Miss Milbourne, who was held in the highest esteem, was extremely popular among a large circle of friends.

EVENING STAR LODGE, No. 1719.

Installation Meeting.

The Installation Meeting of the Evening Star Lodge for the year 1929-30 was held at Freemasons' Hall, Great Queen Street, London, on Wednesday, March 27, and was numerously attended.

The Chair at the commencement of the proceedings was occupied by W.Bro. Arthur L. Croager. The Treasurer, W.Bro. Arthur E. Croager, P.M., P.P.G.D. Kent, presented the report of the Standing Committee and the accounts for the year 1928-29, which showed that the Lodge was in a satisfactory condition.

The installation of W.Bro. James W. Foreman as Worshipful Master for the year 1929-30 was then carried out; the Installing Master being W.Bro. Arthur L. Croager, assisted by W.Bro. H. Packham and W.Bro. A. E. Broadberry, P.M., L.R., as Wardens; and W.Bro. Charles Clare as I.G.

The complete list of officers is as follows:

W.M.	W.Bro. James W. Foreman
I.P.M.	W.Bro. Arthur L. Croager
S.W.	Bro. J. A. Brentnall
J.W.	W.Bro. A. B. Potterton
Chaplain	W.Bro. Frank West, P.M.
Treasurer	W.Bro. Arthur E. Croager, P.M., P.P.G.D. (Kent)
Secretary	W.Bro. Rae P. Normand
Dir. of Cer.	W.Bro. A. H. Henry
S.D.	Bro. T. F. C. Potterton
J.D.	Bro. W. H. Warren
Organist	Bro. J. F. Simmance
Assist. Secretary	Bro. E. J. Fussell
I.G.	Bro. W. F. Broadberry
Stewards	W.Bro. Reg. G. Foster, L.R. Bro. G. D. Bidwell Bro. A. E. Brooks
Tyler	W.Bro. R. H. Goddard

Bro. Harold Charles Smith, of the Moira Lodge, No. 92, Chartered Civil Engineer, Chief Engineer of the Tottenham and District Gas Company, was elected as a joining member of the Lodge, and received a cordial welcome in that capacity.

A Past-Master's Jewel was presented to the Retiring Master as a mark of the members' appreciation of his valued services during the year 1928-29; and he suitably expressed his acknowledgments.

An interesting incident of the evening was the presentation by W.Bro. Walter T. Dunn, P.M., L.R., of a beautifully designed alms-plate, in which was mounted the Past Master's Jewel which was presented to the late Sir John Aird, Bart., who, fifty years ago, had been installed Master of the Lodge, and, as recorded on the back of the jewel, was one of the founders. The mounting has been so devised that it is possible to see, on inverting the plate, the inscription on the back of the jewel. A superincumbent rectangular brass plate has engraved upon it the names of all the officers at the time Sir John Aird was Master. A vote of thanks was passed to W.Bro. Dunn for this very acceptable gift.

After the closing of the Lodge the brethren repaired to the adjoining Connaught Rooms for dinner, over which W.Bro. Foreman presided. The customary masonic toasts were duly observed. That of "The Guests," proposed by W.Bro. A. E. Broadberry, was responded to by W.Bro. A. Mackay, W.M. of the Northern Star Lodge; W.Bro. R. J. Meiklejohn, W.M. of the Murdoch Lodge; and W.Bro. A. Knight-Croad, W.M. of the Junior Engineers Lodge, which was sponsored on its foundation by the Evening Star Lodge.

FORTHCOMING ENGAGEMENTS.

April 12.—NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—Spring Meeting in the Town Hall, Alloa.

April 12.—SOCIETY OF CHEMICAL INDUSTRY.—Joint Meeting of the Chemical Engineering Group with the Birmingham Section, in Birmingham. Paper by Dr. C. M. Walter, of the Birmingham Gas Department, on "The Design and Operation of Gas-Heated Furnaces."

April 13.—WALES AND MONMOUTHSHIRE JUNIOR GAS ASSOCIATION.—Annual General Meeting at Newport.

April 13.—MANCHESTER AND DISTRICT JUNIOR GAS ASSOCIATION.—Annual Dinner and Social. Paper by Mr. S. L. Wright, Colne, on "Hydraulic Mains—Theory and Practice."

April 13.—SCOTTISH JUNIOR GAS ASSOCIATION (EASTERN DISTRICT).—Meeting and visit to Galashiels Gas-Works.

April 13.—LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.—Visit to Works of Lea Bridge District Gas Company.

April 17.—BRITISH COMMERCIAL GAS ASSOCIATION.—Meeting of the Executive Committee in London.

April 17.—BRITISH COMMERCIAL GAS ASSOCIATION.—Annual Meeting of the South-Western District at Exeter at 3.30 p.m.

April 17.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS (EASTERN DISTRICT).—County Meeting at the Old Ship Hotel, Brighton, at 12.30 p.m.

April 18.—MIDLAND JUNIOR GAS ASSOCIATION.—Meeting at Birmingham. Paper by Mr. F. J. Bengough on "Heat Control on Continuous Vertical Retorts."

April 20.—SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT).—Visit to Motherwell and Wishaw Gas-Works.

April 20.—YORKSHIRE JUNIOR GAS ASSOCIATION.—Meeting at Sheffield. Visit to the Orgreave Coke Oven Plant.

April 25.—BRITISH COMMERCIAL GAS ASSOCIATION.—Midlands District Conference at Cheltenham.

April 30.—SOCIETY OF BRITISH GAS INDUSTRIES.—Annual General Meeting at the Hotel Metropole, Northumberland Avenue, W.C.

May 1 and 2.—EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.—Spring Meeting at the Hotel Cecil, London.

May 2.—BRITISH COMMERCIAL GAS ASSOCIATION.—Scottish District Conference at Aberdeen.

May 2-3.—IRON AND STEEL INSTITUTE.—Annual Meeting at the Institution of Civil Engineers.

May 8.—BRITISH COMMERCIAL GAS ASSOCIATION.—Annual Meeting of the Eastern District at Peterborough at 3.30 p.m.

May 10.—BRITISH COMMERCIAL GAS ASSOCIATION.—Manchester District Conference at Southport.

May 10.—SOUTHERN ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—Visit to Exmouth.

May 16.—MIDLAND ASSOCIATION OF GAS ENGINEERS.—Visit to Shrewsbury.

May 16.—WALES AND MONMOUTHSHIRE DISTRICT INSTITUTION OF GAS ENGINEERS AND MANAGERS.—Meeting at Cardiff.

May 24.—NORTH OF ENGLAND GAS MANAGERS' ASSOCIATION.—Annual Meeting.

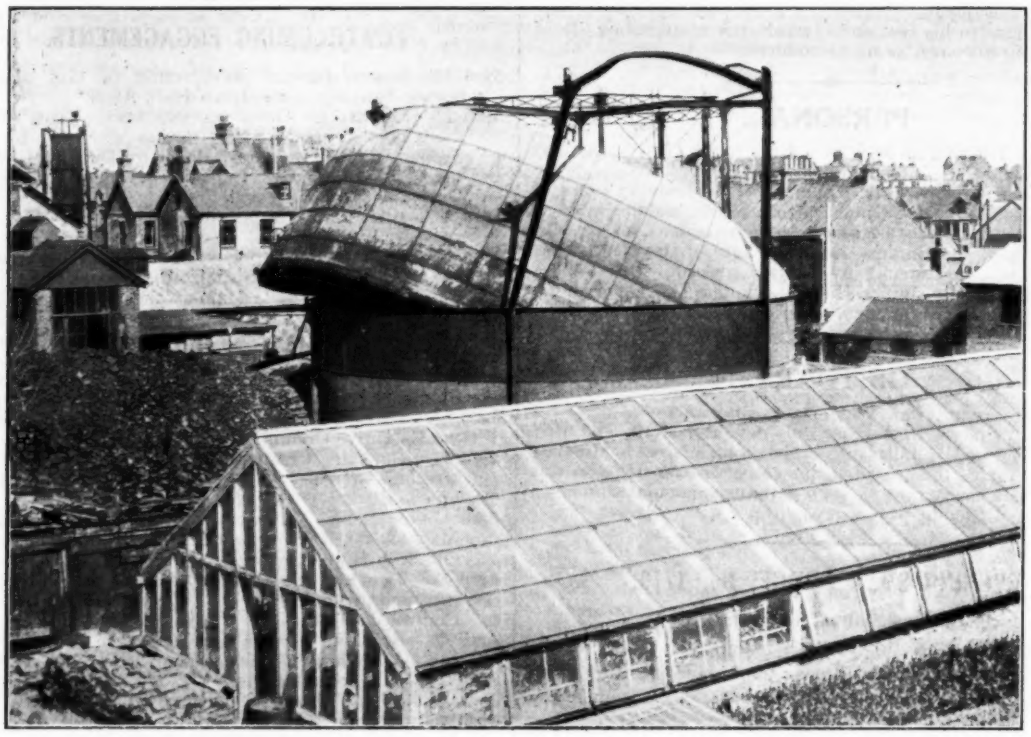
Sept. 12.—NORTH BRITISH ASSOCIATION OF GAS MANAGERS.—Annual Meeting at St. Andrews.

Photometric Chemical Analysis.—Volume II. of Yoe's "Photometric Chemical Analysis"—nephelometry—has just been published by John Wiley & Sons, Inc., 440, Fourth Avenue, New York; price $4.50. Nephelometry is a fairly new science; and Prof. John H. Yoe, Professor of Chemistry at the University of Virginia, is the first to write a complete treatise on the subject. In volume II. he sets forth the advantages and disadvantages, methods, history, &c., of nephelometry, including detailed descriptions of the use of the instruments.

High-Pressure Gas Reactions.—A special course of eight lectures will be delivered in the Department of Chemical Technology, Imperial College of Science and Technology, by Prof. W. A. Bone, F.R.S., and Drs. D. M. Newitt and D. T. A. Townend, on Friday afternoons at 4 p.m., commencing on April 19. The lectures will cover: The organization and equipment of a high-pressure laboratory; the compression of gases and the measurement of high pressures; pressure gauges; the design and construction of high-pressure apparatus; equations of state; compressibilities of gases and liquids; gaseous explosions at high pressures; specific heats of products; dissociation and radiation phenomena; activation of nitrogen and NO-formation in CO-air explosions at high pressures; and catalytic gas reactions at high pressures. The fee for the course is one guinea.

MISHAP TO A RELIEF HOLDER AT NEWQUAY, CORNWALL.

Half-a-Dozen Panes of Glass Suffer.



On Tuesday afternoon of last week, from some unexplained cause, the contents of a small gasholder, used as a Tully gas relief holder, became ignited, and there was a slight explosion. The wind presumably displaced the holder, which came down somewhat overhanging the tank. Fortunately no one was injured, and no metal was thrown about, as stated in one of the daily papers. The only apparent damage consisted of about half-a-dozen sheets of cracked glass in the neighbouring greenhouse, shown in the photograph, being pushed out.

GAS STOCK AND SHARE MARKET.

[For Stock and Share List, see later page.]

BUSINESS on the Stock Exchange last week was mainly confined to the investment markets. With the Bank of England securing gold as it arrived from the mines, no difficulties were experienced in meeting the heavy calls which fell due for payment. While gilt-edged stocks were the most prominent, it was satisfactory to note that Home Rails showed more animation. Speculative descriptions continued in their depressed state, but, despite the lack of interest on the part of the public, quotations on the whole remained firm.

In the Gas Market transactions were well up to expectations. An improvement that was well justified was the rise of 4 points in the Plymouth and Stonehouse 5 p.ct. stock; and having regard to the last dividend, 8 p.ct., paid for the half-year to December, the stock is well worthy of attention, the yield on the average price of 113½ being just over 7 p.ct. It rarely happens, however, that the stock comes into the market. Imperial Continental was again marked up, and is now quoted at 390-410; but otherwise the changes were unimportant. An attractive stock is South Shields consolidated quoted at 106½-107½, yielding nearly 8 p.ct.

The following transactions were recorded during the week:

TUESDAY.—Alliance and Dublin 100, British 119, 120, 5 p.ct. deb. 95, Continental Union 7 p.ct. pref. 126½, European 19¼, 19⅛, 19⅜, Gas Light and Coke 18s. 9d., 18s. 10½d., 19s., 19s. 1½d., 3 p.ct. deb. 60, 5 p.ct. deb. 101¼, Imperial Continental 394, 395, 398, 399, 400, 402, Primitiva 30s., 30s. 1½d., 30s. 3d., South Metropolitan 105⅛, South Suburban 5 p.ct. 108½, 109, 109½, Tottenham 3½ p.ct. 104½. Supplementary prices, Eastbourne "B" 103½, 104½, Rugby new 5½ p.ct. deb. 103.

WEDNESDAY.—Commercial 98½, Continental Union 122½, Croydon max. div. 84, 85, European 19⅛, 19⅛, 19⅝, Gas Light and Coke 18s. 10½d., 19s., 19s. 0⅜d., 3½ p.ct. max. 65, 4 p.ct. pref. 77, 5 p.ct. deb. 101¼, Imperial Continental 395, 396, 397, 398, 400, Primitiva 30s., 30s. 5¼d., 30s. 6d., 30s. 9d., South Metropolitan 105, 105½, 106¼. Supplementary prices, East Surrey 6 p.ct. pref. 101, Rugby new 5½ p.ct. deb. 103.

THURSDAY.—Brighton and Hove 6 p.ct. 115, British 5 p.ct. deb. 94⅜, 95, Continental Union 120, 122, 122½, 123, Croydon sliding-scale 111, 111½, max. div. 84, European 19¼, Gas Light and Coke 18s. 9⅜d., 18s. 10½d., 19s. 0⅜d., 19s. 1½d., 4 p.ct. pref. 77, 5 p.ct. deb. 101¼, Imperial Continental 395, 396, 397, 398, 400, 401, 402, Primitiva 30s., 30s. 3d., 30s. 7½d., South Metropolitan 105½, 105⅜, South Suburban 5 p.ct. 110, 5 p.ct. deb. 98, Swansea 6½ p.ct. deb. 101, Tottenham 3½ p.ct. 103, 4 p.ct. deb. 76. Supplementary prices, Tottenham 5 p.ct. pref. 90⅜, 91.

FRIDAY.—Bournemouth "B" 12$\frac{13}{16}$, 12⅞, Continental Union 120½, 121, European 18⅞, £18 19s., 19, 19¼, Gas Light and Coke 18s. 10½d., 19s., 19s. 1½d., 19s. 3d., 4 p.ct. pref. 76½, 3 p.ct. deb. 59, Imperial Continental 395, 397, 399, 400, Maidstone 5 p.ct. 128½, 129, Oriental 118, Primitiva 30s., 30s. 1½d., 30s. 3d., 30s. 7½d., 30s. 9d., South Metropolitan 104½, 105, 105⅜, South Suburban 5 p.ct. 109, 110. Supplementary prices, Woking District new additional "B" 108¼, 108⅜.

In Lombard Street loan rates were slightly lower than is usual at the close of the week; and while 4½ p.ct. was usually charged for both old and new advances, balances were obtainable at a level 4 p.ct. Discount rates were easier under the influence of the lower Treasury Bill rate, which averaged £4 5s. 9·16d. p.ct., or about 1s. 3½d. p.ct. below the previous week's rate.

A firmer tendency prevailed in the New York exchange, and the final quotation was a shade higher at 4.85$\frac{15}{16}$. French francs depreciated, and closed at 124.22; Italian lire finished at 92.77½; and Belgas moved up to 34.94⅜. Dutch florins were slightly dearer at 12.10½; while Spanish pesetas closed higher at 32.37.

Silver was easier, the price declining to 25$\frac{7}{16}$d. per oz.; while Gold rose to 84s. 11¼d. per oz.

The Bank Rate is 5½ p.ct., to which it was raised from 4½ p.ct. on Feb. 7. The Banks' deposit rate is 3½ p.ct., and the deposit rates of the Discount Houses are 3½ p.ct. at call and 3⅜ p.ct. at notice.

BLOOMSBURY EXPLOSION.

Findings of the Commissioners.

The Commissioners appointed by the Home Secretary to inquire into the circumstances of the series of explosions and fires which occurred on Dec. 20 and 21 last, in the neighbourhood of New Oxford Street, have issued their report.* The Commissioners were Mr. R. G. Hetherington, O.B.E., M.Inst.C.E. (Chairman); Lieut.-Col. R. A. Thomas, C.B.E.; and Mr. E. H. Tabor, M.Inst.C.E.; and a full report of the proceedings at the Home Office Inquiry has been published in the "JOURNAL"—see Vol. 185, pp. 50, 87, 105, 229, 290, 361, 429. Below we give the substance of the report as it affects the gas industry, together with the Commissioners' conclusions and recommendations.

It will be remembered that the theories were advanced that the explosion might have been due to petrol vapour or anærobic fermentation gases. Both these theories, however, are dismissed by the Commissioners, and they arrive at the conclusion that the source of the explosion was coal gas. They state that positive evidence showed the presence of coal gas in the tube at the time of the explosion. They call attention to the escapes of gas into the tube and connected chambers from April, 1928, onwards, and to leakages of gas in the explosion area in 1927 and 1928.

"It was generally admitted," observe the Commissioners, "that there was a *primâ facie* case indicating coal gas as the explosive agent; and in our opinion this has not been upset but confirmed by the inquiry. Apart from the fact that there are in our view insuperable difficulties in accepting any other explanation, the coal gas theory is consistent with all the facts. It is clear that the presence of coal gas in the tube was suspected, by officials of both the Gas Company and the Post Office, at least since April, 1928; and attempts to locate the source of the trouble were only suspended in September pending the completion of the work on the 48-in. main, which, it was thought, might have revealed a point of leakage. Finally, the only direct evidence available—that of smell when the manhole was first opened on the morning of the explosion—appears to us to confirm that coal gas was present in the tube immediately before the explosion." Accordingly, they state with confidence that the explosion was due to a mixture of coal gas and air.

"If the gas in the tube had accumulated gradually," they continue, "the period available may have been considerably longer than the seventeen days during which the tube was closed from Dec. 3 to 20. From the Post Office records it appears there was no occasion to enter any of the manholes west of the Post Office after Nov. 13, nor to enter the Post Office or Kingsway manholes between Nov. 18 and Dec. 3. The opening of the two eastern manholes on Dec. 3, and the ventilation by the blower of the section of the tube between them, though it would probably completely clear that section, would certainly not clear the western section of the tube. Thus if there had been any gas coming into the western section after Nov. 13, it had about five weeks to accumulate before the explosion. Our conclusion is, therefore, that it is quite impossible after the event to trace with certainty the precise source of the gas; and while we recognize the possibility of a large inrush from some untraced source such as a fractured main shortly before the explosion, we are inclined to the view that the gas was present as the result of a gradual accumulation extending over a considerable period, probably increased within a short time of the explosion by an escape not necessarily large in itself, but sufficient to increase the concentration to the explosion limit."

IGNITION OF GAS.

Regarding the source of ignition of the gas, it is observed that the evidence of Brooks, Downing, and Rowell (three Post Office workmen) is consistent with the ignition of the gas by Thrower's use of a lighter, but it cannot be accepted as positive proof.

"Although we cannot accept the evidence as to the lighter as conclusive, we think that it is probable that Thrower did in fact use a lighter to enable him to find the socket which he had never used before. . . . We wish to make it clear that, if no evidence of any kind as to a lighter had been submitted to us, we should still have come to the conclusion that the ignition of the gas was caused by some action on the part of one of the three Post Office workmen, probably Thrower."

The Commissioners state that, in their opinion, the blower employed in the Post Office tube itself was adequate for its specific purpose—namely, the clearing of sections of the tube before work was begun.

The following sections are reprinted from the report.

RECOMMENDATIONS.

VENTILATION.

It was represented to us by the Engineer-in-Chief of the Post Office that it is safer to allow gas to accumulate in an underground chamber or other cavity, so that its release can be controlled, than to allow it to escape by a system of continuous ventilation. In his view there would be danger of volumes of gas being ignited while escaping through a ventilator into the air, firing back and exploding. We do not dispute the risk, but it seems to us to be very much less than that due to absence of ventilation. A large and sudden inrush of gas directly into a space such as the tube could hardly be dealt with by any practicable system of ventilation, but such an occurrence is unlikely, and much less probable than a gradual accumulation from small escapes. An accumulation of the latter character could be rendered harmless by continuous ventilation. We consider that, in choosing between the two risks, it is preferable to provide against the more probable contingency.

A distinction was also drawn by the Engineer-in-Chief between subways in which there is plant—*e.g.*, electric supply cables—containing in itself the potential means of igniting inflammable gas, and places, such as the tube, in which there was only innocuous plant (except the lighting and power circuit which was carefully protected). It appears to us that, while the distinction may be just in principle, the human element cannot be disregarded, and the habitual entry of men into such places for repairs or maintenance in itself involves a risk of ignition of any gas that may be present. It would, we consider, be safer to treat any such place in the same manner as one containing plant having the potential means of ignition.

The Engineer-in-Chief laid stress on the necessity for protecting the Post Office plant from damage due to damp or dirt; but, if it is the case that the provision of perforated covers for manholes in the streets would involve undue risk from this cause, so as to make it impossible to provide adequate ventilation without more elaborate measures, we are of opinion that, in the interests of safety, the more elaborate measures should be taken.

Wherever gas escaping from a main is unable to find a free vent into the atmosphere, it will remain under the surface of the road; and if convenient cavities are available, it will tend to accumulate therein. It follows that the existence of any cavity beneath the ground without any outlet into the open air is a potential danger, and the danger is proportional to the size of the cavity. Our general view is that any structure forming such a cavity of any considerable size should be adequately and continuously ventilated, or, if disused, filled in or removed. The practical point which needs consideration is where to draw the line. It is obvious that it is not practicable except at heavy cost to ventilate every chamber constructed under a street, nor is it in our opinion necessary. In small chambers, such as footway boxes of normal dimensions, constant ventilation is not essential; but chambers such as manholes on duct or pipe lines, and other chambers which are constructed for a man to enter and work in, should, we consider, have constant ventilation, and we do not think that the provision of such ventilation would involve expenditure or risk of damage to plant which it is unreasonable to face in view of the additional safety thereby obtained. It may be that in certain circumstances the provision of adequate ventilation is not practicable; and if there are any such cases, it seems to us that special care should be taken to provide against risks due to the possible accumulation of gas.

We now return to the special problem presented by the Post Office tube. The section of the tube which was destroyed by the explosion is to be replaced by lines of ducts laid in the ground, so that our observations will apply only to the other sections of the tube.

We entered a portion of the tube east of Kingsway for the purpose of acquainting ourselves with the structural condition of a section not affected by the explosion. We found the air good, but the entrance to the tube from the Holborn Telephone Exchange was open at the time, and we cannot therefore speak as to the ventilation when the entrance is shut. There does not, however, appear to be any arrangement for its continuous ventilation in normal circumstances.

We have not examined any other portions of the tube, but we were informed that in the section which lies in the Borough of St. Pancras continuous ventilation is provided by pipes running up the walls of buildings, and by ventilators on street refuges. This ventilation was provided before the Post Office took over the tube.

We recommend that the whole of the existing tube should

* This report is obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 1s. 6d. net.

be examined at once, and that an adequate system of continuous ventilation should be installed where it does not at present exist. This recommendation is not based on fear that the districts in which the tube is situated are specially liable to escapes. So far as we are aware, there are no distinguishing features in those districts. It is based on general principles emphasized by the circumstances connected with the explosion.

Leakage of Gas.

In order to give warning of the presence of gas, some form of continuous detector, if installed in such places as the Post Office tube or important underground chambers, would provide an additional safeguard to a system of continuous ventilation; and we think that the possible employment of such apparatus is worthy of consideration. We understand that more than one such apparatus are available, but we have not considered it part of our duties to make an investigation of the merits of any particular appliance.

Another matter to which our attention has been directed is the organization of the Gas Company for dealing with leakages. We have formed the opinion that the Company's organization for promptly repairing leakages is extremely good, but we think that it contains a weak spot in so far that information as to leakage appears to be treated too much as a matter of routine, and does not ordinarily come to the notice of sufficiently responsible officials who are in a position to appreciate the full significance of all the facts. This is not said in any way in criticism of any of the officials of the Gas Company, whose time is without doubt fully occupied on important matters; but we are of opinion that the Company should strengthen their organization in such a way to make it the primary duty of some responsible officer to control the work of leakage detection and be responsible for judging the true significance of any report of leakage received. This would ensure a competent opinion being formed as to whether any leakage might injuriously affect any other undertaking or private property, and the taking of necessary steps to warn the owners.

OBSERVATIONS ON GENERAL QUESTIONS.

In the course of our inquiry our attention has been directed to certain incidental questions which appear to us to require further consideration. A proper examination of the questions would take a long time, and could hardly be made without obtaining evidence, over a wide area, of a kind which did not seem to us to come within our terms of reference. We therefore confine ourselves to indicating what seem to be the most important of these questions.

Subways.

There are at present in London about seven miles of subways for mains and pipes, some of which contain gas mains varying in size from 2 in. to 48 in. The general view of the witnesses we have heard appears to be that subways are desirable for water mains and for low-tension electric mains, but that they are unsuitable for high-tension electric mains, owing to the explosive effects of a breakdown, and that it was preferable that gas mains should be laid in the ground. Subways possess obvious advantages, such as avoiding the necessity to open streets for maintenance and repair, and facilitating inspection of mains. The disadvantages placed before us by witnesses may be illustrated by the statement of Mr. Doig Gibb that electric cables and gas mains would never live at peace in the same conduit; and he went on to say that by "electric cables" he meant any cables which would give a spark sufficient to fire a gaseous mixture.

Depth of Mains.

A great number of existing gas and other mains were laid many years ago when the road surfaces were very different from those now in use, and when the traffic passing over the streets was much less as well as lighter and slower than it is to-day. Some difference of opinion exists as to how far modern conditions have increased the vibration passing through the ground, thereby imposing a greater strain on the mains; and the question seems to us to be one which would well repay detailed investigation. A further difficulty in this connection is that in the case of new mains it is frequently impossible, owing to the congested state of the ground beneath the road, to lay them in the best positions for satisfactory maintenance and minimizing the effect of vibration. Moreover, the presence of other services—and sometimes, as in the area which we have been examining, the existence of cellars and vaults—under the street makes it necessary for mains to follow a devious course, which undoubtedly increases the risk of breakage.

Co-Ordination.

It seems to us to be a matter for serious consideration whether in London there is not the need for more co-ordination in the control of underground services. Possibly the best means of providing this co-ordination would be to set up some body whose function might be to collate information as to underground services at present in existence, and to take every opportunity which presented itself—*e.g.*, by the reconstruction of streets—to simplify the disposition, and, if necessary, to require the alteration of the lines and levels of existing mains. Similarly, it might be given powers to require the submission of plans of new mains for approval, in order that, so far as possible, congestion should be avoided and trunk mains not required for local supply should be allocated to specific routes. It might also be desirable to give this body some measure of control over cellars and vaults constructed under the street, as these at some places occupy a large proportion of the subsoil. Possibly also it might be empowered to make and enforce regulations as to the ventilation of manhole chambers and other underground structures. It is true that at present the Highway Authorities have some control over vaults and cellars and the laying of mains in their streets, but it is a question whether the objects which we have indicated above can be attained by any authority whose powers are not greater than those at present possessed by Highway Authorities, and whose jurisdiction does not cover the whole of the urban area in and around London. It is clear that no rapid results could be expected from a co-ordinating authority of the kind we have adumbrated; and it follows from this that the longer the conditions remain as at present, the more complicated would be the problem to be faced by any such body which might be set up in the future.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

Conclusions.

The first explosion occurred at about 8 a.m. on Dec. 20, 1928. It took place in the section of the Post Office tube or cable subway extending from Kingsway to St. Giles' Circus, and originated in the manhole on the tube outside the West Central District Post Office in High Holborn. East of the point of origin there was only one explosion; on the west there was either one prolonged explosion or a series of closely following explosions. At about 8.5 a.m., at the corner of Grape Street and Broad Street, gas escaping from a main fractured by the explosion was ignited, probably by residual flames. Shortly after the extinction of this fire (about 12.30 p.m. on Dec. 20), another, but unconnected, fire broke out at the corner of High Street and Denmark Street, where gas escaping as a result of the explosion was ignited, and a building in which films were stored caught fire. It is not clear how or where this fire started. The escaping gas continued to burn until the afternoon of Dec. 21.

The explosion was due to a mixture of coal gas and air. We have not been able to trace the precise source of the gas, but it was probably a gradual accumulation of leakage from neighbouring gas mains extending over a considerable period, increased by some larger untraced escape within a short time of the explosion. The gas was ignited in the manhole by some action on the part of one of three Post Office workmen, who were preparing to clear the air in a section of the tube with an air pump or blower. It was probably due to the use of a petrol lighter in the manhole by P. G. Thrower, who unfortunately received fatal injuries.

The workmen followed the usual procedure preparatory to the use of the blower; and cannot be criticized for doing so. In order to operate the blower, it was necessary to enter the tube and make a connection with a socket, the position of which had been determined before the provision of the blower. The fact that the position of the socket was not altered when the blower was provided so as to be accessible from the ground was a contributory cause of the explosion, but it cannot be said that, if it had been altered, the explosion would not have taken place.

Recommendations.

Any structure forming an underground cavity of any considerable size should be adequately and continuously ventilated, or, if disused, filled in or removed. All chambers such as manholes on duct or pipe lines constructed for a man to enter and work in are included in this recommendation.

The whole of the existing Post Office tube should be examined at once, and an adequate system of continuous ventilation should be installed where it does not at present exist.

The employment of some form of continuous detector to give warning of the presence of gas in places such as the Post Office tube or important underground chambers is worthy of consideration.

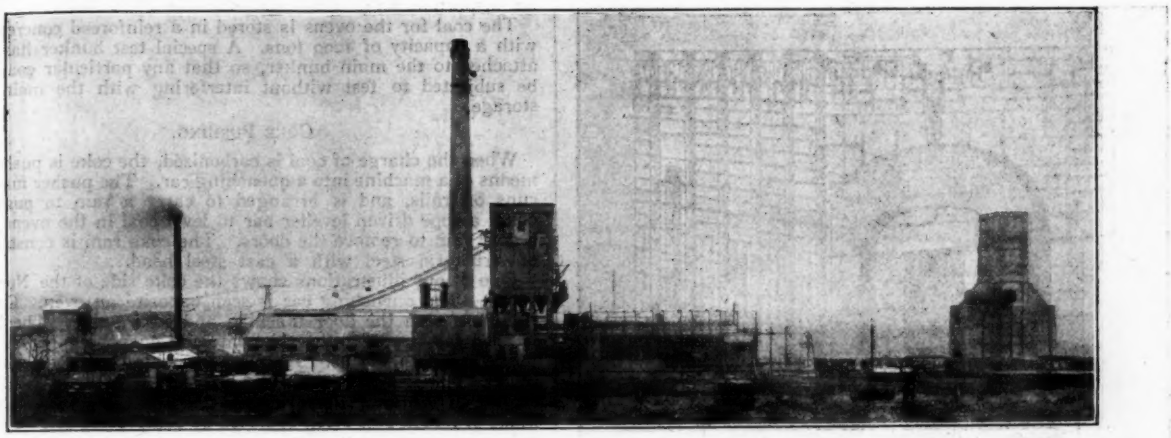
The Gas Light and Coke Company should strengthen their organization so as to bring the work of leakage detection under the control of some responsible officer as his primary duty.

Coal Tar Industry of Japan.—Statistics published in the "Journal of the Fuel Society of Japan" give the annual production of coal tar in that country during recent years at about 120,000 tons, of which 70,000 tons is derived from coke ovens and 50,000 tons from gas-works. Of the total output, 90,000 tons is distilled. The demand for pitch for road purposes is steadily increasing in Japan; about 37,000 tons being used for the purpose during the first six months of last year. Creosote is now being exported to the United States. Last year 5000 tons, produced at the Imperial Steel Works, Yawata, were exported, and further business in this direction is expected. The recovery of benzole from coke oven gas is being seriously considered at a number of works owing to the increasing demand for motor fuel.

BRITAIN'S FIRST BECKER COKE OVEN INSTALLATION.

PLANT AT THE HANDSWORTH WORKS OF THE NUNNERY COLLIERY COMPANY, SHEFFIELD.

This Becker plant has been built on a new site at the Handsworth Works with the object of securing by the coking process a more remunerative outlet for the coking slacks of the Nunnery Colliery Company. The surplus gas is sold to the Sheffield Gas Company.



GENERAL VIEW OF BECKER COKE OVEN PLANT AT THE HANDSWORTH WORKS OF THE NUNNERY COLLIERY COMPANY.

Showing (reading left to right): Coal transfer station, boiler plant, bye-product building, coke screening station, coal storage bin, Becker ovens, and coke quenching station.

The past few years have seen great advances in coke oven practice. Post-war developments in the coking industry throughout the world have been on lines of:

(1) Larger capacity ovens.
(2) Quicker coking times.
(3) More economical heating arrangements.

(1) Ovens of larger capacity have been attained by increasing the height and length of the oven, the limits of increase being mainly governed by:

(*a*) The problems of temperature regulation in order to maintain even heat distribution; and

(*b*) the design of structure in order to maintain strength and solidity.

In increasing the capacity of modern ovens in this way, the older types of flue arrangement were incapable of dealing with the increased volumes of heating gas necessary, without making them of such large dimensions that the structure of the ovens was weakened, and was incapable of withstanding the stresses developed in heating up and working the ovens. The modern large-capacity oven therefore necessitated the re-design of existing heating arrangements.

(2) Quicker coking times have been made possible by improvements in oven design, the narrowing of the ovens, and the use of higher flue temperatures, which, in turn, depends upon the use of high-grade silica bricks to withstand the high temperatures.

(3) Provided attention is paid to correct design as regards flue areas, regenerators, heat insulation, &c., economy in heating the oven will automatically follow the first two points—larger capacity ovens and quicker coking times. In addition, developments have been along the lines of arranging that the correct amount of fuel gas can be burnt at any portion of the oven.

It was to meet these new requirements that the Becker oven was designed. The remarkable progress the Becker oven has made can be seen from the fact that, though the first Becker oven plant was put to work in America in 1923, to-day Becker plants in various parts of the world are either in operation or under construction capable of carbonizing over 30 million tons of coal per annum (nearly as much coal as is carbonized annually in all the gas-works and coke ovens in Great Britain).

Becker ovens are to be found in America, Canada, Belgium, France, Holland, Italy, and Russia, and now the first British Becker oven plant is in successful operation at the Handsworth Works of the Nunnery Colliery Company, Sheffield. This, therefore, is somewhat of an event; and the plant may be regarded as being worthy of a detailed account.

The Becker oven plant is built on a new site at the Handsworth Works with the object of securing by the coking process a more remunerative outlet for the coking slacks of the Nunnery Colliery Company. The surplus gas is sold to the Sheffield Gas Company.

Each week this Becker oven plant at Nunnery is now producing 2800 tons of coke, 50 tons of sulphate of ammonia, 36,000 gallons of tar, and 13,600 gallons of crude benzole, and is delivering about 27 million c.ft. of debenzolized gas, with a calorific value of 550 B.Th.U. per c.ft., to Sheffield.

The Oven Battery.

The battery consists of 25 Becker regenerative ovens, arranged to operate with coke oven gas as fuel, but so designed that with minor exterior changes such as gas piping connections, &c., they can be operated with clean producer gas. The ovens are 40 ft. 8 in. long from door to door, 12 ft. 6 in. high, and have an average width of 14 in. The capacity per oven is 12 tons. The oven brickwork from the pad upwards is constructed entirely of first-quality silica bricks, with the exception of the regenerator bottom liners and fillings and the end walls adjacent to the reinforced concrete pinion walls. The oven tops, oven jambs, and regenerator faces are insulated. The oven tops are paved with paving bricks.

At each end of the battery is a concrete retaining wall, built with suitable wing walls. A waste-gas flue is built on each side of the battery. The flues are concrete, lined with firebrick. The oven stack is 200 ft. high, lined a quarter of the way up with firebrick.

It may be of some interest to compare the new ovens with the old ovens at Nunnery, in order to see more readily the extent of modern progress.

—	New Ovens.	Old Ovens.
Type	Regenerative	Waste heat
Width	14 in.	20 in.
Garbonizing time (gross)	12 hrs. 50 min.	32 hrs.
Capacity per oven	12·2 tons	7 tons
Capacity per oven per 24 hours	22·7 ,,	5·2 ,,
Surplus gas, c.ft. per ton dry coal	7000 c.ft.	*Nil*

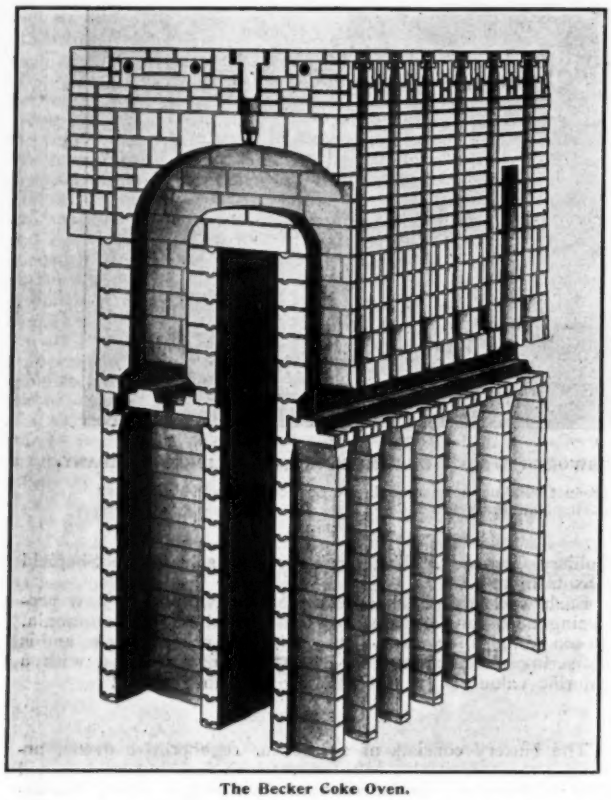
Features of the Becker Oven.

The outstanding feature of the Becker oven is the system of heating which claims to overcome all the difficulties associated with the modern, large-capacity, quick coking oven in the simplest way, while at the same time ensuring a high thermal efficiency. The basic feature is the cross-over flue.

In the Becker oven there is a series of vertical flues on each side of each oven. There are two regenerators under each series of vertical flues. Air, which is introduced into these regenerators, travels up and burns with coal gas in the vertical combustion flues, up which the combustion gases travel in parallel for the full width of the oven. The gases are then collected from each four or five vertical flues, and are carried over the top of the oven by means of a cross-over flue. There are six cross-over flues to each alternate oven; no cross-over

flues being required for the intermediate oven. From the cross-over flues the waste gases are distributed into vertical flues exactly opposite the flues up which they have travelled on the opposite side of the oven. They travel down the vertical flues and are equally distributed in the two regenerators below the flues down which they have passed.

The employment of the cross-over flue enables all flues to be of small dimensions, in spite of the big volume of gases to be handled. The travel of the gases is short and the speed slow, so that excellent regulation can be obtained with a low pressure differential. The heating gas in all the vertical flues always travels in a parallel direction, and there is no danger of short-circuiting and consequent loss of efficiency.



The Becker Coke Oven.

Section through cross-over flue at top of oven. There are six cross-over flues in a 40-ft. oven.

Though the oven width increases from the pusher side to the coke side so as to facilitate pushing, the quantity of gases burning in each vertical flue is graduated from the pusher side to the coke side, so that the oven charge at the wider end of the oven is carbonized in the same time as the narrower end.

OVEN CHARGING.

The ovens are top charged by means of a coal charging car. This consists of four steel hoppers of approximately 12½ tons capacity. Each hopper has an adjustable measuring device and a cast-iron drop sleeve operated by one lever interlocked with the traction motor, so that the car cannot be operated with sleeves down. There are four charging holes in each oven. The coal, before charging, is weighed on a weighbridge.

Through ascension pipes from each oven the gas passes into a collecting main of steel construction. Flushing sprays are installed in each ascension pipe and at each alternate oven in the collecting main. In order to ensure accurate regulation of pressure in the gas collecting main, a butterfly valve is employed, controlled by a Shallcross governor. Flue inspection covers are also placed on the battery top. Each vertical flue has an inspection hole.

The coal for the ovens is stored in a reinforced concrete bin with a capacity of 1200 tons. A special test bunker has been attached to the main bunker, so that any particular coal may be subjected to test without interfering with the main coal storage.

COKE PUSHING.

When the charge of coal is carbonized, the coke is pushed by means of a machine into a quenching car. The pusher machine runs on rails, and is arranged to carry a ram to push the coke, a rope driven leveller bar to level coal in the ovens, and a door ram to remove the doors. The coke ram is constructed of structural steel with a cast steel head.

One of our illustrations shows the coke side of the Nunnery ovens. The quenching car is seen opposite an oven. On the right are seen the door machine and coke guide. The latter is used for directing the coke into the quenching car as it is pushed from the ovens. The coke quenching car has a capacity of approximately 9 tons. The body is 40 ft. long and has a sloping bottom of cast-iron plates. The car has four side gates made of ribbed cast steel, operated by compressed air. The car is hauled by an electric locomotive.

COKE QUENCHING.

Coke quenching is carried out at a central quenching station consisting of a brick tower. The hot coke is brought by the electric locomotive in the quenching car, which is run under the tower, and the coke is quenched with a predetermined amount of water. The quenched coke is then taken back to the ovens, and spread out on the wharf before delivery to the screening plant. The quenching tank has a capacity of 10,000 gallons, and water is fed to the sprays through a 12-in. feed line. Two quenching water pumps are installed, each with a capacity of 20,000 gallons per hour (one stand-by to the other). The pumps are automatically operated by float control in the overhead quenching tank.

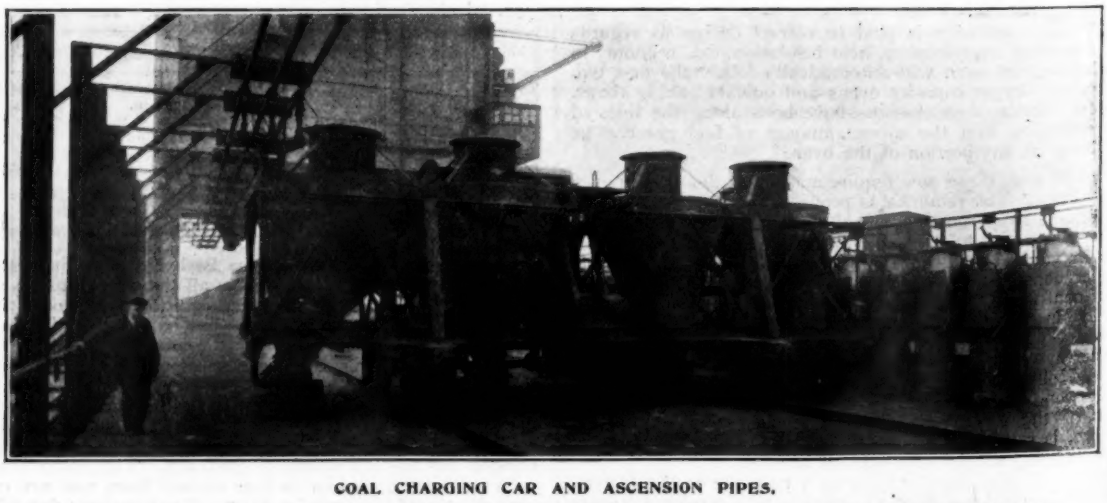
OVEN HEATING ARRANGEMENTS.

A steel main conveys the coke oven gas required as fuel for the ovens. The quantity of fuel gas used is recorded and integrated by a venturi type meter.

Reversal of flow of combustion gases is effected through 104 reversing valves arranged 52 on each side of the battery. These control the passage of air from atmosphere through the regenerator, and of waste gases from the regenerator to the stack. Reversing is effected automatically every 20 minutes by a single machine connected to the individual gas cock levers and reversing valves.

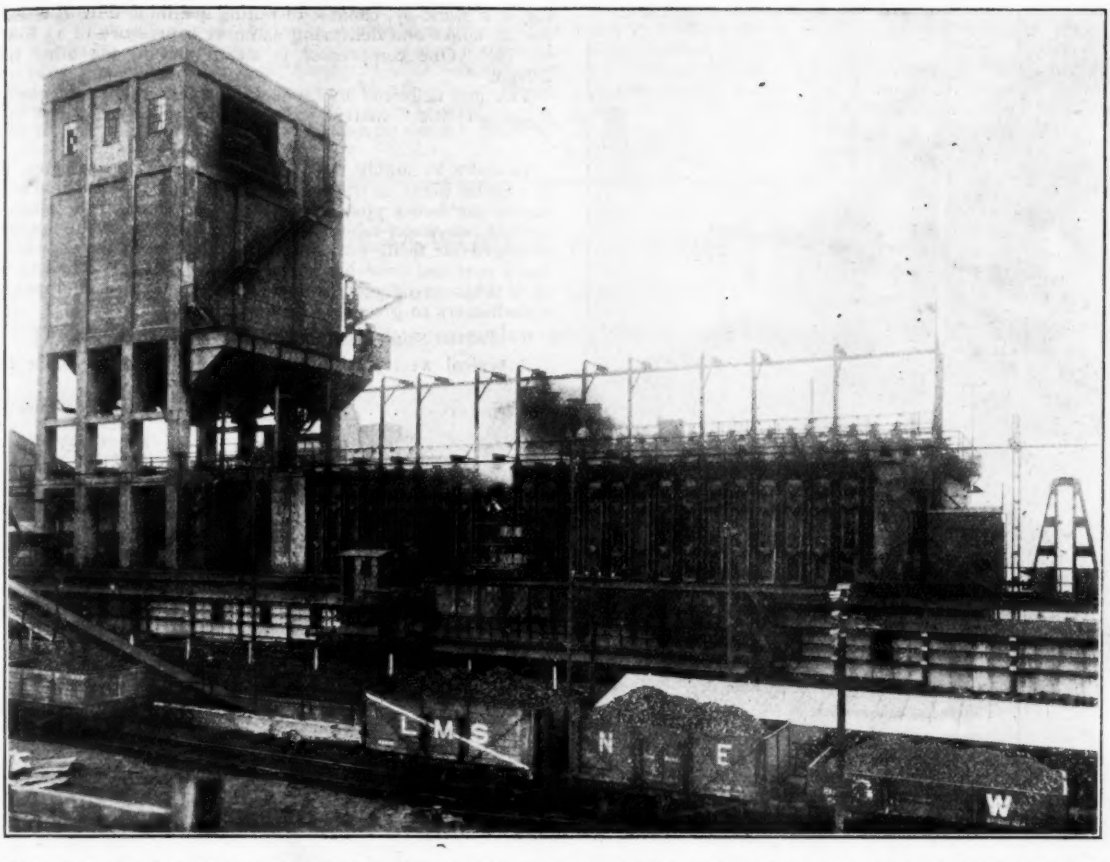
AMMONIA RECOVERY.

The process of ammonia recovery employed in conjunction with the Becker oven installation at Nunnery is termed the "semi-direct" process, and may briefly be described as follows: The gas is drawn from the ovens by the exhausters to



COAL CHARGING CAR AND ASCENSION PIPES.

The flue inspection covers are shown on the battery top, together with charging holes. Each vertical flue has an inspection hole.



COKE SIDE OF BATTERY, SHOWING QUENCHING CAR WITH ELECTRIC LOCOMOTIVE AND CLAY CARRIER LOCATED OPPOSITE OVEN.

On the right-hand side are the door machine and the coke guide; and on the left-hand side are the coal bin and the test hopper.

the primary coolers, which are of the indirect vertical water cooled type. In these the tar, naphthalene, water vapour, and a certain amount of ammoniacal liquor are condensed. The cooled gas then passes through the exhausters and is delivered into the tar extractors, where the remainder of the tar in the gas is removed. The gas then passes on through reheaters, where its temperature is raised to such a point as to ensure efficient production of ammonium sulphate, which takes place when the gas is bubbled through sulphuric acid in specially designed saturators. After passing through the latter, the gas enters an acid separator, where any traces of acid which may have been carried over from the saturators are removed.

The sulphate of ammonia formed in the saturator is lifted to a drain table by means of an ejector, and is afterwards dried in a centrifugal machine. The sulphate is then neutralized, and further dried before bagging.

The ammonia liquor, which is condensed in the primary coolers, is separated from the tar and distilled. The resultant ammonia vapours are delivered into the main coke oven gas stream just before it enters the saturator.

The bye-product plant at Nunnery is situated in a building of steel-framed brick-filled construction with a crane runway supported on the columns the full length of the building. This building houses the exhausters, tar extractors, reheaters, saturators, acid separators, drain table and driers, ammonia still and pump, and lime and sulphate handling and storage equipment.

The two exhausters (one working, one stand-by) are of the positive type, direct connected, steam engine driven, capable of delivering gas at a discharge pressure of 3½ lbs. maximum and 2½ lbs. normal pressure. The tar extractors are a special design of the rigid bell type.

The saturators, two in number, are constructed of a cylindrical steel shell resting on a cast-iron bottom. The whole saturator is lead lined and contains a lead cracker pipe. The salt is ejected from the saturators, by bronze ejectors, into a drain table consisting of a lead lined cast-iron box. The sulphate centrifugal driers are of the suspended self-balancing type, driven by high-speed vertical steam engines.

The ammonia still is of sufficient capacity to distil all the ammonia condensates, and contains six trays in the free section and nine trays in the fixed section. The sulphate is neutralized and dried in a Phillipson machine; ammonium carbonate being employed as the neutralizing medium.

In the bye-product house are also situated the liquor flushing pumps and the tar and liquor pumps. The flushing pumps have a capacity of 24,000 gallons per hour against a differential head of 60 lbs. gauge, and supply the liquor for flushing the collecting mains. Large steel tanks are installed for storing tar and ammonia liquor separately.

Gasholder.

In order to maintain a constant pressure of gas on the battery, and to act as a reservoir for the booster, a double-lift gasholder of a capacity of 100,000 c.ft. has been built.

Benzole Recovery Plant.

In order to recover the benzole from the gas, the latter, on leaving the bye-product building, passes through the final coolers and then into benzole scrubbers which consist of tall towers, 80 ft. high, packed with wooden hurdles. The gas passes through these towers in an upward direction, and comes in contact with descending streams of wash-oil which absorb the benzole. The debenzolized gas passes away from the top of the towers.

The wash-oil, enriched with benzole, is delivered into a specially designed distilling apparatus provided with the necessary heat exchangers, condensers, and coolers. In this apparatus the benzolized oil is debenzolized by intimate contact with steam. At Nunnery, the wash-oil is a heavy petroleum.

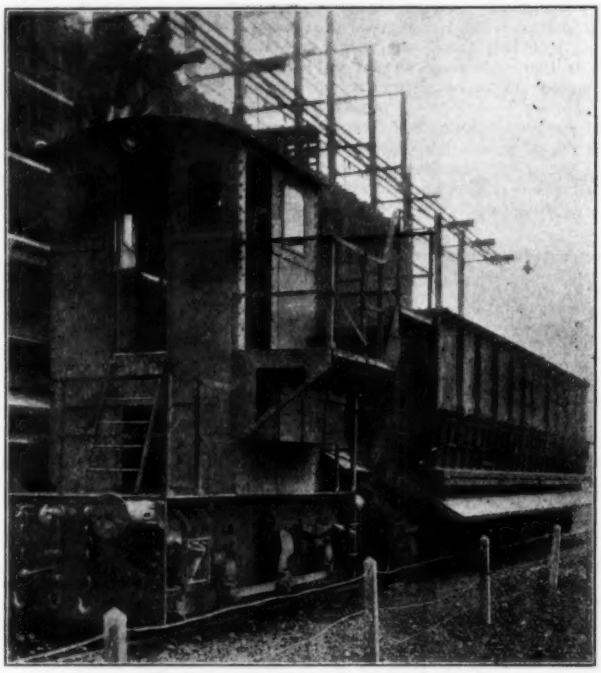
In order to effect heat economy, two heat exchangers are provided. In the first, the heat from the light oil vapours is transferred to the cold benzolized oil. In the second, the heat from the oil leaving the still is used to preheat the benzolized oil. Both these heat exchangers are of the vertical tube type.

After passing through the still, the wash-oil is cooled in an open type cooler consisting of five banks of 2-in. galvanized pipes. The banks are arranged so that any one can be by-passed and steamed out. The crude benzole is also condensed in an open type cooler, from which it passes to a separator wherein the water is removed, and thence to storage tanks.

The benzole plant, which occupies a separate building, was designed to produce crude benzole distilling 65 p.ct. at 120° C.; but in practice the benzole recovered tests 70 to 80 p.ct. at 120° C.

Coal Handling.

Slack coal previously cleaned on dry tables of the Peale-Davis system is delivered to the transfer station hopper by an aerial ropeway. It passes through a disintegrator, and is crushed so that 75 p.ct. passes ¼ in. The disintegrated coal is then taken from the transfer station by means of a further ropeway, and is dumped into the battery bin at the coke ovens. This ropeway is built on the double rope system with separate



Electric Locomotive and Coke Quenching Car.
The latter has cast-steel bogie frames.

fixed carrying ropes and hauling rope. It is approximately 500 ft. long and carries 85 tons of coal per hour. The average gradient is 1 in 4. The installation is automatic; the carriers requiring no attention from the time they leave the loading station until they return empty to this point, when they are automatically released from the hauling rope and stand ready to load again.

Coke Handling Plant.

Coke is pushed by the machine into the quenching car, pulled by an electric locomotive, and quenched at the central station. The coke is then brought back to an inclined wharf at the ovens, and allowed to cool off. From the wharf it is fed by finger gates on to a belt conveyor, and delivered to a 2½-in. rotary grizzly screen. The oversize is delivered on to a cross belt conveyor and passed direct into trucks. Provision is made for the coke over 2½ in. to be cut when required and delivered to a rotary screen sizing o-½ in., ½-1 in., 1-1½ in., and 1½-2½ in. The screened coke falls into bins, from which it is discharged directly into rail wagons.

The Nunnery plant is thus laid out to supply either blast furnace coke, or, alternatively, coke carefully graded into different sizes for the industrial and domestic markets.

Gas Boosting Plant.

For the purpose of supplying the surplus gas to the Sheffield Gas Company, two gas compressors are installed, one operating, one stand-by, capable of taking 4 million c.ft. of clean gas per 24 hours and delivering same at a pressure of 15 lbs. per sq. in. One compressor is steam driven, the other motor driven.

The gas delivered to Sheffield is measured by means of a "Connersville" meter.

Boiler Plant.

In order to supply the steam necessary for the plant, there is a boiler plant of the Babcock & Wilcox type capable of producing per boiler 7500 lbs. of steam per hour. The plant consists of two water-tube boilers. The furnaces of the boilers are arranged for firing either with pickings from the screen belts, small coal and coke breeze, or surplus gas. The boilers work at a pressure of 150 lbs. per sq. in., and are equipped with superheaters to give 100° Fahr. superheat.

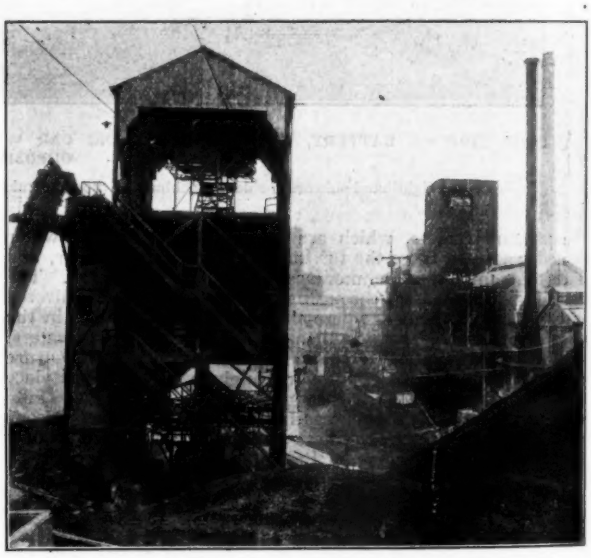
Some Results on the New Plant.

A typical week's results on the new plant are to be found below:

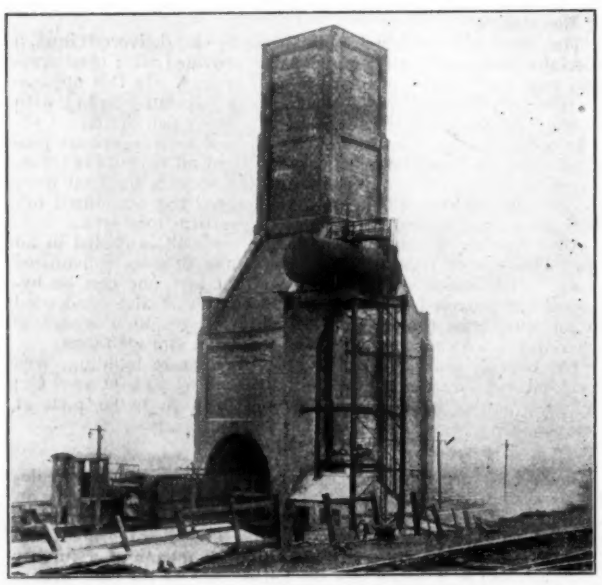
Types of coal	South Yorks and Derbyshire mixed
Size	75 p.ct. through ⅛ in.
Coal carbonized per day (dry)	543 tons
Average charge per oven (coal as received)	12·2 tons
Average coking time, net	12 hrs. 38 mins.
" " " gross	12 hrs. 51 mins.

Yields Per Ton of Dry Coal.

Gas (corrected to 60° Fahr. and 30 in. debenzolized)	11,210 c.ft.
Calorific value (B.Th.U. per c.ft. at 60° Fahr. and 30 in. Hg. moist)	553·4 B.Th.U. (gross)
Tar	10·21 galls.
Ammonium sulphate	31·53 lbs.
Benzole (75 p.ct. at 120° C.)	3·54 galls.
Coke	15·38 cwt.
Percentage of total gas make available for sale	62·6 p.ct.



General View of Coal Handling Arrangements by Aerial Ropeway.
Clean coal is delivered to the transfer station hopper by aerial ropeway, is disintegrated, and then conveyed by further ropeway to the oven storage bin. In the background will be seen the benzole plant and the bye-product plant, and on the extreme right the boiler plant.



Coke Quenching Station, consisting of Brick Tower, Overhead Water Tank, Pump House, and Breeze Settling Sumps.

Gas Analyses.

(*a*) Crude gas in collecting main.

	P.Ct.
H_2S	2·0
CO_2	2·0
O_2	0·1
N_2	3·5

(*b*) Gas at outlet purifiers to calorimeter service (as delivered to Sheffield).

	P.Ct.
CO_2	2·2
O_2	0·8
C_nH_m	3·0
CO	6·8
H_2	52·6
CH_4	28·2
N_2	6·4
	100·0

These results will generally be regarded as reaching a high level of efficiency. A make of surplus gas available for sale of over 7000 c.ft. per ton with a calorific value of over 550

B.Th.U. per c.ft., coupled with a benzole yield of over 3½ gallons of high-value crude benzole, shows that this type of plant efficiently conserves the bye-products of coal carbonization. The gas analysis, too, is worthy of note. A nitrogen content of only 3½ p.ct. in the crude gas collecting main speaks well for the gas-tight construction of the oven battery.

The Nunnery installation truly earns its name as a "modern" coking plant. The entire plant was designed, constructed, and put to work by the Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd.

In conclusion, grateful acknowledgment is made to Mr. N. E. Webster, O.B.E., General Manager, and the Directors of the Nunnery Colliery Company, Ltd., for permission to publish the above particulars of their new installation.

NEW GAS-WORKS AT JOHANNESBURG.

Adoption of the Glover-West System.

[From a Brochure prepared in connection with the Inauguration Ceremony on March 26.]

GENERAL VIEW OF THE WORKS.

Johannesburg was proclaimed a township in 1886, following the discovery of gold in the Main Reef in 1885. This discovery led to the establishment of the greatest gold field in modern times; and the population of the township has sprung from 50 in the year of its proclamation to over 300,000 to-day, while the rateable value has risen to £53,000,000. Johannesburg as the centre of the Transvaal Goldfields now produces £80,000,000 worth of gold per annum, which is 50 p.ct. of the world production. In 1888, only two years after the foundation of the township, a Company, called the Johannesburg Lighting Company, obtained a concession for the public lighting of the streets and supply to the inhabitants, and a gas plant was designed and brought out from England. This apparatus was brought up by bullock wagon from the Port of East London, some 700 miles, and practically the whole of it was in commission until the closing-down of the old works at President Street in 1928.

The supply of gas was first commenced on June 23, 1892, and the plant continued to function without interruption till it was closed down on Dec. 23, 1928, when the new works at Cottesloe were brought into operation. During that time the only alterations made were the addition of a gasholder of 150,000 c.ft. capacity in 1896, and the building, in 1913-14, of a new horizontal retort house. The annual output increased from 11,355,000 c.ft. in 1892 to 109,301,000 c.ft. in 1928. The price of gas was originally 21s. per 1000 c.ft. with coal at over £4 per ton, but this has been gradually reduced to the present figure of 6s. per 1000 c.ft.

In 1895 the assets of the Company were acquired by the Sanitary Board, then the only Local Authority, which eventually developed into the Municipal Council with the Gas and Electricity Department as one of its many interests.

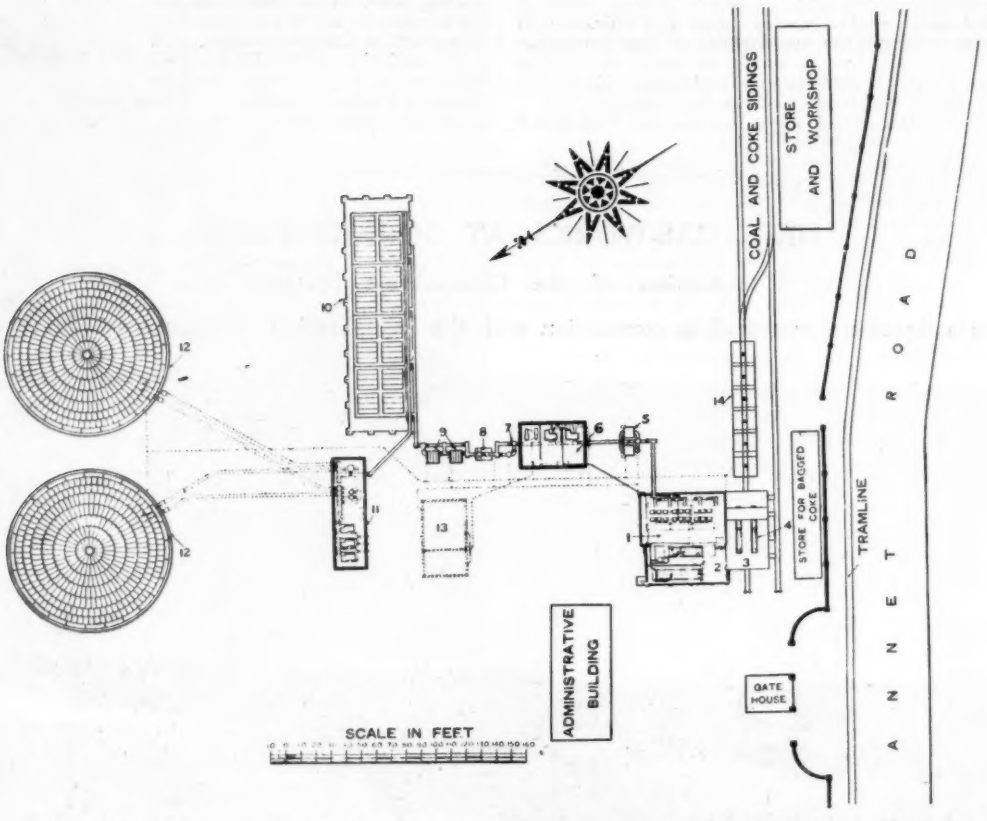
As an indication of the value of the gas-works to the town, it may be mentioned that during its 36 years of life this small undertaking has paid over £25,000 in rates, as well as contributing over £180,000 to the relief of rates, and meeting all capital, renewals, establishment, and other charges.

It became evident immediately after the conclusion of the war that the public demand for gas was steadily growing, and it was decided to place the gas undertaking in a sounder position. In 1926 a scheme and specification were prepared and issued by Mr. B. Sankey, General Manager of the Gas and Electric Supply Department, and tenders were invited for the construction of a complete new gas-works at Cottesloe.

In January, 1927, Mr. W. R. Herring, the well-known British Consulting Engineer, was engaged to report upon the several tenders which had been received; and on Feb. 25 he submitted an extremely interesting report, an abstract of which was given in our issue of May 18, 1927, p. 428 (see also Vol. 178, pp. 105 and 181).

The removal of gas-making operations from the original site has provided much-needed space for extensions to the Electricity and Tramways Departments. From the time that the provision of gas and electricity was taken over by the Sanitary Board, these two Departments were controlled by one Committee and operated on the same piece of ground at the President Street Power Station. From the date of the operation of the new works the two Departments have been divided, and a separate Engineer and Manager has been in charge of the Gas Department. Mr. H. M. Tysoe was appointed to this office early in 1928, and the erection of the new works has taken place under his general supervision. The work has been designed throughout in such a manner that extensions can be made with a minimum of cost; provision for duplication having been made at all points.

So important is the process of carbonization that "any want of economy here (and the word 'economy' implies efficient apparatus, proper conditions of working, and good management generally) cannot be compensated for in any of the subsequent stages or processes to which the gas is to be subjected,



1 Carbonizing Plant.
2 Boiler House.
3 Coke Storage Hoppers.
4 Rotary Coke Screens.
5 Condensers.
6 Exhauster and Liquor Pump House.
7 Tar Extractor.
8 Livesey Washer.
9 Washer Scrubber.
10 Purifiers.
11 Station Meter, Governor, and Booster House.
12 Gasholders.
13 Underground Tar and Liquor Tank.
14 Underground Coal Store.

GENERAL PLAN OF THE WORKS.

or through which it has to pass before it reaches the consumer."

The continuous system of carbonization in vertical retorts has already established itself as fulfilling the requirements of the foregoing paragraph.

The Glover-West System Adopted.

The installation at Cottesloe comprises 18 Glover-West "New Model" vertical retorts, 40 in. by 10 in. in cross-section at the top, and capable of carbonizing 100 short tons per diem of South African coals.

Following the trend of development in modern carbonizing plant, this installation is fully equipped with apparatus for the recovery of the surplus heat from the retort bench after the work of distillation is completed. The Spencer-Bonecourt induced-draught firetube boiler fitted is designed on the principle that, in the transmission of heat from the products of combustion to water, the velocity of the gases and the shape of the heating surface are the items to which attention must be paid, rather than to the actual amount of heating surface, and, further, that this requirement shall be varied with the initial temperature of the gases and with the velocity of flow. Such a boiler, with tubes of length greater than fifty times their diameter, and coupled to a fan creating a difference of draught of 1 in. W.G. or more between the inlet and outlet products chambers, is completely protected by patents.

In the present instance the hot gases are drawn through 282 tubes, 1¾ in. in diameter by 18 ft. long, presenting a heating surface of 2325 sq. ft., by means of an electrically-driven fan with a water-cooled impeller bearing and equipped with a regulating damper in the discharge throat. The fan unit is designed for a 20 p.ct. continuously-rated volumetric overload above the normal calculated volume of gases to be passed through the boiler and waste-gas flue circuits; due allowance being made for the increased water gauge at such overload. The evaporative capacity of the boiler and superheater is 6000 lbs. of water from and at 212° Fahr. when the 18 retorts are in operation. This steam is used to actuate the exhausters and some of the pumps, as well as in the gas-making process itself.

In addition to the usual high-grade mountings and fittings, the boiler is equipped with automatic feed regulator and "Hilo" alarm, which regulates the supply of feed-water to the boiler, maintains the water in the boiler at a constant level, and gives the alarm if that level should vary beyond predetermined limits. The waste gases from the retort bench are conveyed to the boiler in steel flues lined with a double ring of firebricks and insulating bricks.

Lancashire Boiler.

Steam is also raised from the combustion of coke breeze in a Lancashire boiler constructed by Messrs. Galloways, Ltd. The boiler is 8 ft. in diameter and 30 ft. long, and is capable of an evaporation of 5000 lbs. of water from and at 212° Fahr. when fired with breeze containing 30 p.ct. of ash.

The furnace is of Wilton's patent forced-draught type, and the boiler is followed by a superheater capable of raising the temperature of the steam 120° Fahr. above that of saturation. The boiler is operated under induced draught, rendering a tall chimney unnecessary; the gases being drawn through the boiler by an electrically driven fan direct coupled to a 5-H.P. motor with damper and control gear.

Both boilers are inter-connected and arranged to deliver steam at a pressure of 120 lbs. per sq. in., and both the boilers and the whole of the steam ranges throughout the works are efficiently lagged to reduce loss by radiation to a minimum. The feed-water is supplied to a tank from which suitable feed pumps force the water into either boiler at will. Three pumps are provided so that when both boilers are in operation together two pumps will be working, leaving a third as a stand-by to either. These pumps were constructed and supplied by Messrs. Weir.

Coal and Coke Handling Plant.

Coal is brought to the breaker either from the band conveyor leading from the underground coal storage bunkers, or through the receiving hopper direct from the railway wagons. From the breaker the broken coal passes into the boot of a fixed bucket elevator which raises the coal and discharges it into the buckets of the lip-bucket conveyor. This conveyor fully encircles the retort bench, raising the coal and distributing it into the several compartments of the overhead storage bunkers, and, returning below, receives the coke from the chambers underneath the retorts, conveying and elevating it to the screens above the storage hoppers. An automatic conveyor-weigher is arranged in the track of the conveyor with two totalizers giving the record of the weighings of coal to, and coke from, the plant.

The West lip-bucket conveyor encircling the retort bench is itself an important advance in the design of labour-saving machinery. The combination of large bearing surfaces with efficient lubrication and protection against the abrasive effects

of coke is the latest development of West's Gas Improvement Company's 55 years' experience with coal and coke handling machinery.

The retort bench is built within a steel-framed retort house, with a generous supply of platforms and staircases leading to all parts of the system. In addition there is an electric lift with semi-automatic push-button control specially designed and adapted for this duty. This lift is designed for a lifting capacity of one ton at a speed of 70 ft. per minute, and forms a valuable stand-by for the elevation of coal and coke within the retort house as may be required, and it is fully equipped with such safety devices as render it suitable for passenger purposes giving access to the various levels of the retort plant without fatigue.

The coke screens, of West's rotary type, are arranged in duplicate above a battery of reinforced concrete storage hoppers capable of containing about 280 tons of coke in several graded sizes. Each compartment is provided with gear-controlled outlet doors for discharge into railway wagons; and a bag-filling platform, with specially designed bag-filling chutes, is provided for the retail trade.

Auxiliary Plant: Condensers.

From the retort house the gas is taken through a retort house governor, maintaining constant pressure conditions within the carbonizing plant, to the water-tube condensing plant in which the major portion of the tar separates out. This piece of apparatus is capable of dealing with 2 million c.ft. of gas daily, and consists of two cast-iron columns fitted with steel tubes presenting a total water-cooled surface of over 10,000 sq. ft. to the passage of the hot gases from the retort bench. This portion of the plant was constructed by Messrs. C. & W. Walker, Ltd., of Donnington.

Exhausters.

The gas is drawn through the condensers and forced through the remainder of the auxiliary plant by machinery constructed by Messrs. Geo. Waller & Son, Ltd., of Stroud; the exhausters being of their well-known four-blade type, in duplicate. Each machine is capable of dealing with 100,000 c.ft. of gas per hour when running at the designed speed of 75 r.p.m. against a total gas pressure equivalent to 40 in. head of water.

Each exhauster is direct driven by a horizontal steam engine with 10-in. diameter cylinder, 12-in. stroke, suitable for a steam pressure of 120 lbs. per sq. in. The engines are fitted with variable expansion gear for the economical utilization of the steam, metallic packings, and automatic lubrication, and with Waller's latest pattern steam regulating apparatus.

Tar Extractors.

Following the exhausters is a Pelouze & Audouin tar extractor, supplied by Messrs. W. C. Holmes & Co., Ltd., of Huddersfield, of their patent columnless, latest design.

Following the "P. & A." tar extractor is a Livesey washer supplied by Messrs. C. & W. Walker, which removes nearly the last traces of tar from the gas.

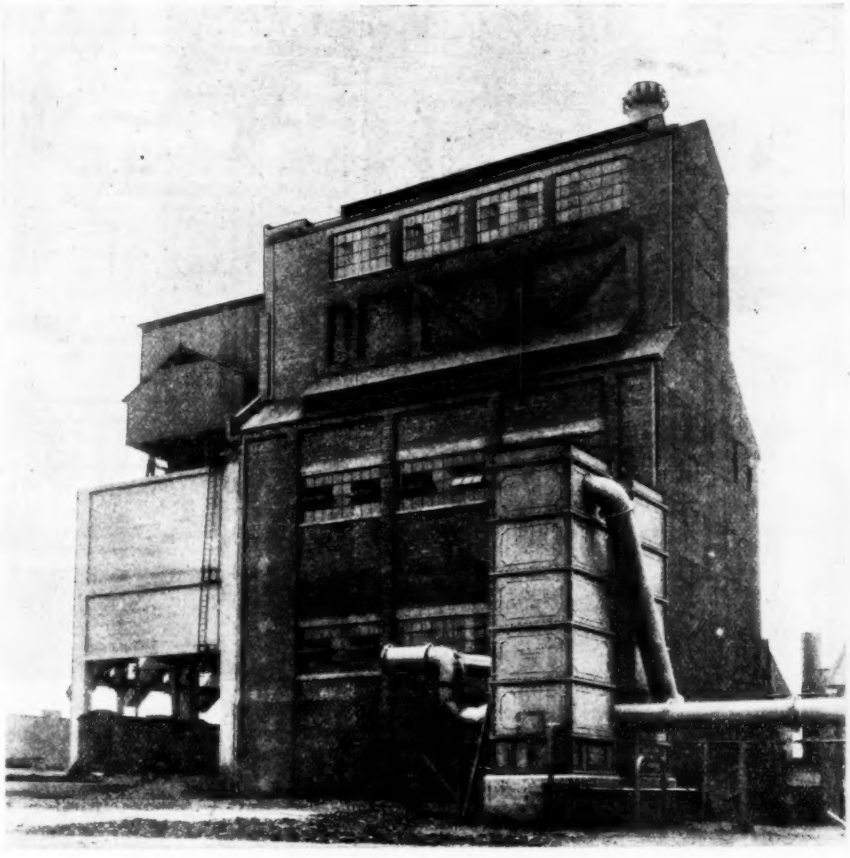
The ammonia is removed from the gas in a rotary brush washer constructed on the most modern principles by Messrs. W. C. Holmes & Co.

Two electrically-driven tar and liquor pumps are provided and fitted up in the pump house, each capable of pumping 2500 gallons per hour against a head of 100 ft. They have been manufactured by Messrs. Joseph Evans & Sons, and are driven through compound gearing and Verity's "Aston" electric motors.

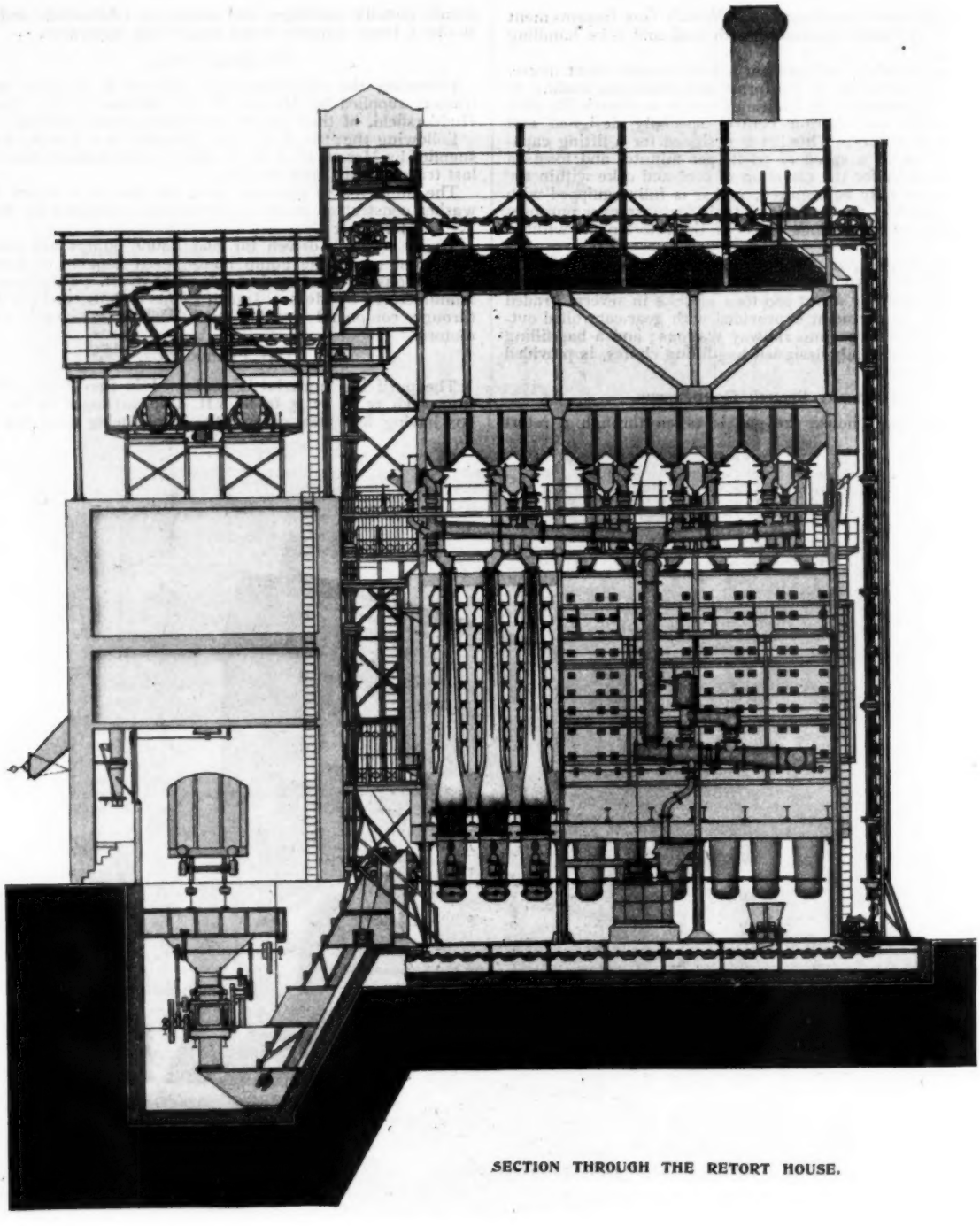
Dry Purification.

The purifying material is contained in four boxes of cast-iron, each 35 ft. by 35 ft. by 6 ft. deep, arranged in line, each box having four steel covers; the whole being arranged above ground level upon a girder floor, with a roof covering of asbestos protected corrugated sheeting carried upon steel roof principals. The purifier covers are of the luteless type; the gas-tight joints between the covers and the boxes being maintained by a rubber pad secured to the covers on the Milbourne-Beard patent principle. The covers are handled by worm gear blocks travelling on longitudinal joists fixed to the underside of the steel members and operated from the top of the purifiers. The boxes are fitted with four tiers of timber grids which support layers of oxide, and the spent oxide is discharged through chutes to the revivifying floor below; each box being provided with four chutes closed with self-sealing gas-tight lids. The gas valves and connections are arranged alongside the purifiers; the valves being of the Milbourne patent duplex type, and the connections arranged so that the boxes can be worked in forward or backward rotation at will. Each box is also fitted with a Milbourne patent reverse-flow valve at the inlet and outlet, which enables the travel of the gas to be either upwards or downwards through the purifying material as may be required.

The oxide is handled by worm gear blocks travelling on longitudinal joists fixed underneath the purifiers, and also underneath the roof principals. The fresh oxide is loaded into



THE GLOVER-WEST RETORT HOUSE AND WALKER CONDENSERS.



SECTION THROUGH THE RETORT HOUSE.

skips on the ground floor, and raised by means of the blocks to the level of the purifiers.

Station Meter.

The meter installed at Johannesburg is of the rotary type, manufactured and supplied by the Rotary Meter Company, of Manchester, and is capable of measuring within 1 p.ct. fast or slow from 100,000 c.ft. of gas per hour down to 10,000 c.ft. per hour. The interior of the meter is constructed of the best tinned iron, and the guide passages of highly glazed porcelain, while the fan is made of aluminium. The bearing of the revolving portion is of such a form that friction is almost entirely eliminated. It consists of two flat, highly polished surfaces working on opposite sides of a highly polished spherical ball. Careful attention has been paid to the design of the oiling arrangements. The whole is enclosed in a strong cast-iron case with joints faced and turned with inlet, outlet, and by-pass connections of 24 in. diameter. The bonnet or cover is hinged, so that it can be lifted for convenience in examining the indices when required.

Gasholders.

The gasholders, two in number, are constructed by Messrs. C. & W. Walker on the spirally-guided principle; each holder having a storage capacity when fully inflated of 500,000 c.ft. Each holder is at present constructed with two lifts, working telescopically, and is so made that a further lift can be added in the future with the minimum of inconvenience, increasing the storage capacity by one-half.

Station Governors.

The pressure of gas for transmission to the district is maintained at a suitable constant figure by means of two station governors, each with 14-in. diameter connections, provided by Messrs. Peebles & Co., of Edinburgh. The governors are pressure loaded; the loading being controlled by a small air bell placed in the Manager's office.

An important feature of this system is that smaller weights are required for changing the pressures, because the air bell, which determines the pressure, is only a third of the area of the governor bell. Double-balanced gunmetal valves working in gunmetal seatings are used, having perforated tapered openings which deal with small quantities of gas. The governor bell and the air bell are made of finest quality tinplate, and a counterbalance arrangement is used with the governor instead of a float.

High-Pressure Transmission.

While the pressure in the immediate district is controlled by the station governors, for transmission to greater distances

boosting machinery has been provided. The high-pressure plant was supplied by Messrs. George Waller & Son, and consists of three electrically-driven positive rotary gas compressors of their four-blade type; each unit being capable of dealing with 40,000 c.ft. of gas per hour against a maximum discharge pressure of 5 lbs. per sq. in.

The compressors are fitted with entirely automatic lubrication, and each machine is driven by a Verity pipe-ventilated shunt-wound motor of 24 H.P., suitable for direct current at 220 volts. The drive is transmitted through double-helical machine-cut reduction gear, totally enclosed in cast-iron gear cases with oil-bath lubrication.

The compressors deliver into three separate 8-in. discharge mains; the pressure from these being reduced to district pressure as required through three 8-in. Waller deadweight diaphragm district governors.

Gas Mains.

The mains throughout are 24 in. in diameter, and each piece of apparatus is fitted with inlet, outlet, and by-pass valves; the valves being of a type to suit the nature of the apparatus to which each is fitted. Those mains which conduct the gas from the retort house to the condensers, and thence through the exhausters, tar extractors, washers, purifiers, and to the inlet of the meter, are placed at a minimum height of 7 ft. above the ground, being thus always open to direct inspection. They are arranged at a suitable inclination, so that condensates within the mains drain back into the syphon pots of the several pieces of apparatus; and they are generally constructed of riveted mild-steel plates with cast-iron bends and junctions. From the meter to the gasholders and back to the governors and boosters, the mains are of cast-iron; and they are placed underground.

Throughout the arrangement preparation has been made for duplication, and all by-passes have branches to which future apparatus can be coupled with a minimum of disturbance to gas-making operations.

Thermometers and pressure-gauges are fixed at all important positions in the system of mains, so that the management can observe the conditions of temperature and pressure throughout the processes.

To connect the new works with the existing distribution system, a trunk main has been laid from Cottesloe to the old site in President Street, consisting of 1800 ft. of 24-in. main, 7360 ft. of 20-in., and 820 ft. of 16-in., all of which are steel tubes with butt-welded seams.

Contractors.

The main contract was placed in the hands of Messrs. West's Gas Improvement Company, Ltd., in collaboration with Messrs. Blane & Co., of Johannesburg. Messrs. C. & W. Walker have manufactured the gasholders, purifiers, condensers, and works mains. Other specialists have supplied such items as have been mentioned in the foregoing. The major portion of the steelwork has been manufactured and erected by Messrs. Gilbert Hamer, of Durban, while the foundations and buildings have been constructed by Mr. A. Stewart, of Germiston.

Work Carried Out by the Municipal Council.

In addition to work done under the main contract, the following work has been carried out: The boundary wall and fence, the gate house, the main administrative buildings, the workshop and store, the power house, and the cooling ponds and tower, with pumps for water.

The combined workshop and store is 115 ft. long by 36 ft. wide, and is built on the platform above the railway siding. In it is housed the meter repair and testing department; and all spare parts for the services and works are kept here.

The main administrative buildings house both engineering and clerical staff, and the basement contains garages and stores for records.

The power house, which has been built adjoining the boiler house, contains two Browett-Lindley compound steam engines direct coupled to Electric Construction Company 75-KW. direct current generators. As a stand-by, the local supply of 3000 volt alternating current is transformed down and converted in a 75-KW. General Electric Company rotary converter.

Johannesburg is 5700 ft. above sea level, and all water is obtained either from boreholes or from the Rand Water Board's Vaal River Barrages. This necessitates pumping to 1500 ft.; and water is therefore costly. With this in mind, all roof drainage throughout the works has been carried to two settling and cooling ponds; and cooling water is pumped to the condensers by an electrically-driven centrifugal pump, and flows to the top of the cooling tower.

OBSERVATIONS ON AMERICAN GAS ENGINEERING PRACTICE.

By S. G. Watson, M.Sc. (Leeds), of Messrs. W. C. Holmes & Co., Ltd., London.

[London and Southern District Junior Gas Association, March 22.]

(*Concluded from p.* 32.)

Metering of Gas.

Speaking broadly, it may be said that in America some form of positive meter is used almost exclusively, and inferential types do not receive very serious consideration. The positive type is divided into two classes—viz.:

(*a*) The drum type, familiar to European practice.
(*b*) The impeller type which recently has been adopted also in England.

The drum meters do not differ greatly from our own, except that they are rated for higher capacities than ours and in some cases the external shell is made in steel instead of cast iron, as is our usual practice. These steel shells are stiffened externally by suitable angles and tees, and they appear to be a very workmanlike and satisfactory job, and are cheaper than cast iron. The desirability of economizing in ground space, with an additional attraction in the saving of initial outlay, has led to the impeller type of positive meter being widely adopted; and this type has undoubtedly displaced a considerable number of drum meters.

Although several examples of the impeller type meter have been working as station meter in Great Britain during the last few years, very little information concerning them has appeared in the Technical Press, and a brief description of their construction and performance may be of interest.

Fig. 5 gives a sectional elevation through the end of this type of meter, as manufactured by the Connersville Blower Company, of Connersville, Indiana, and will be seen to be very similar to the exhauster described in this paper, in that essentially it consists of two impellers constructed to arcs of circles and involute curves, these impellers rotating within a closed casing. The impellers are separated from the casing by fine clearances, and their relative positions are maintained by gears at both ends of the shafts. Gas is admitted to the top of the machine and rotates the impellers in an outward direction. The volumetric displacement per revolution can be both calculated and determined, and therefore the gas passing through the machine may be measured in the same manner as with the drum meter—namely, by counting the revolutions of the shaft.

Since the impellers do not touch the casing, the possibility arises that gas may "slip" from inlet to outlet past the impellers and escape measurement.

Three factors govern the magnitude of any possible slip:

(*a*) The size of the clearances through which the "slip" is to take place.

(*b*) The pressure difference, across the clearance, available to cause the "slip."

(*c*) The specific gravity of the gas.

The adverse effects of these three factors are minimized by, firstly, using working clearances as small as possible compatible with a reasonable allowance for expansion, &c.; secondly, by using suitable bearings for the impellers so that they will rotate with a very low pressure difference—usually of the order of 5/10 in. water gauge. The third factor is constant for gases of similar composition.

By careful attention to the points given above, the actual slip in these meters over a wide range of throughput is usually not more than about 0·75 p.ct.; and since this slip can be, and is, definitely determined, it is incorporated into the counter, which therefore reads substantially correctly and requires no further correction over the given range. This range is from 10 p.ct. of the rated capacity to double the rated capacity.

Where it is desired to meter gas at rates considerably below the lower limits of accuracy for the machine, and it is undesirable that any correction should be applied, a combination has been developed in which an impeller meter is used in conjunction with a high capacity dry meter. An automatic shift valve controls the operation so that the impeller meter measures the gas at the high rates, while low rates of flow, down to the limits of (say) ordinary pilot jets, are metered by the dry meter. This type of tandem meter is suitable for stamping after in-

spection by the State Examiner, and is widely used in the metering of gas for industrial purposes.

Table VIII. is reproduced from a paper entitled "Station

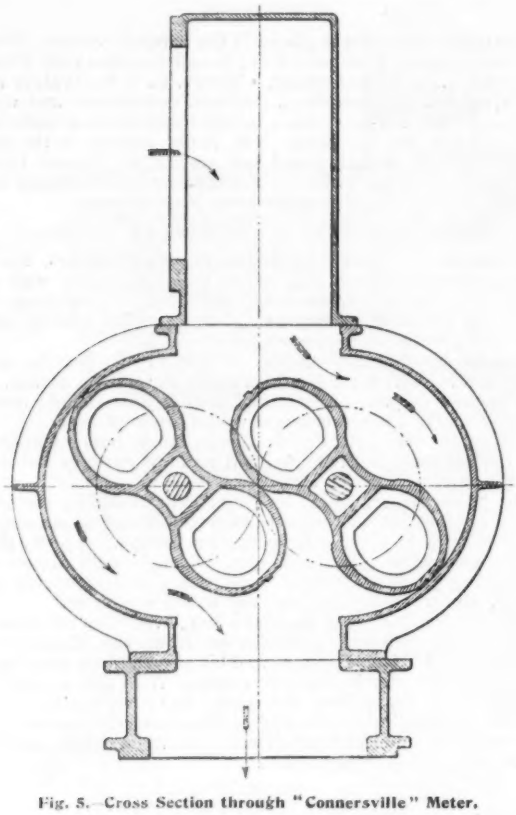


Fig. 5.—Cross Section through "Connersville" Meter.

Meters Compared," delivered to the Indiana Gas Association by Mr. P. J. Wilson, representing the summary of a test occupying eleven days, during which the readings of a "Connersville" meter and wet drum meter were compared.

TABLE VIII.—*Comparison of Readings obtained with "Connersville" Meter and Wet Drum Meter running in Series*

2/11-24.	Corrected Gas—1000 Ft.		Difference.	
	Connersville.	Wet Meters.	1000 Ft.	P.Ct. of Connersville.
2/12-14	3,792	3,775	+ 17	+ 0·45
2/14-15	1,933	1,911	+ 22	+ 1·1
2/15-16	1,923	1,916	+ 7	+ 0·3
2/16-17	1,809	1,804	+ 5	+ 0·3
2/17-18	1,862	1,856	+ 6	+ 0·3
2/18-19	2,013	2,003	+ 10	+ 0·5
2/19-20	2,047	2,046	+ 1	+ 0·05
2/20-21	2,047	2,050	− 3	− 0·1
2/21-22	2,055	2,048	+ 7	+ 0·3
2/22-23	1,866	1,866	0	0
Total	21,347	21,275	+ 72	+ 0·34

Similar comparative tests have been made with equally satisfactory results on numerous Connersville station meters in Great Britain.

The popularity of this type of meter is reflected in the observation that there are over 600 installed in various gas-works and coke ovens in America; and they appear to give satisfaction and to justify the claims that have been made for them.

Their robust construction, together with their being "self-cleaning," has resulted in their being widely adopted for metering crude gases, such as water gas, before mixing with coal gas or coke oven gas before sale in bulk for distribution.

CONCLUSION.

I think it will be agreed that, speaking broadly, there is fundamentally a great deal in common between American and British gas practice. We may differ somewhat in detail in the secondary and subsidiary processes in gas manufacture, but essentially we have the same problems. We are both endeavouring to supply gas to the consumer as cheaply as possible; to show him how he may use his gas as economically as possible; and to convince him that the commodity we supply is that which is the best for the purpose he has in mind.

It will be agreed, also, that, in our respective endeavours to develop our sales of gas, we must always bear in mind that in the manufacture of gas there are essentially bye-products; and these must not only be manufactured economically, but produced to the specification most suitable for their ultimate use, and then placed before the purchaser in a manner sufficiently attractive to invite his attention. It is common to both countries that the efficiency of production and sale of such products as coke, tar, ammonia, &c., is reflected ultimately in production cost and selling price of gas; and in the sale of our primary product, gas, we both have serious competition to face.

The basis of our future prosperity would appear to be progress based on careful research and experiment both in the laboratory and in the works. We in the gas industry in Great Britain have shown ourselves to appreciate fully the value of research, and it is encouraging to know that the Universities in America are also studying the vital problems of the industry, and invite our co-operation. I can speak personally of the work of the Mellon Institute, Pittsburgh, and the Massachusetts Institute of Technology, and there are many more such institutions.

In closing, may I make my acknowledgments of the invaluable assistance given me by West's Gas Improvement Company of America, the Koppers Company of America, the Connersville Blower Company, Connersville, Indiana, and numerous other friends in America, and also to Messrs. W. C. Holmes & Co., Ltd., of Huddersfield, and to your President for his kind invitation to read this paper.

Discussion.

The PRESIDENT, after expressing the thanks of the meeting to the author, said that Mr. Watson had just returned from a long visit to America where he had been investigating the problems of gas-works operation there. The type of carbonizing plant in almost universal use there, as described in the paper, was probably controlled by the fact that the demand was for a very hard dense coke for domestic heating apparatus, though in many of the smaller works both horizontal and vertical retorts were adopted. Since the war a great deal of attention had been given to condensation in this country, and the design of plant had been altered to create better conditions, because it had been realized that the conditions of temperature affected the composition and quality of the gas to no small extent. The question of atmospheric *versus* water cooled condensers was one which seemed, as far as England was concerned, to be narrowed down to a personal choice, because there were still some people who favoured shock cooling, in spite of the alleged fact that there was a much greater reduction in the calorific value of the gas with shock cooling as compared with atmospheric cooling. At the same time, it seemed to be the general practice that, where atmospheric cooling was adopted during the summer months, it was necessary to finish off with water cooling. As to exhausters, fig. 2 of the paper was very interesting; and he would like to know at what speed that exhauster would run when it was dealing with 140,000 c.ft. of gas per hour, as compared with the speed at which it would run when dealing with 220,000 c.ft. per hour, because, though there might be less wear due to internal friction, what was gained there might be lost to some extent by the extra wear and tear on the driving gear. Referring to ammonia recovery, the President said that from the point of view of general gas-works practice he would prefer the type of washer scrubber to which they were accustomed here rather than the type of intensified washer described in the paper. Gas engineers in this country, however, would do well to study the references made to the purification of gas from H_2S by the various liquid processes described by the author. It seemed strange that some of these processes had not been more adopted in this country. Possibly one of the reasons was that, whereas the average sulphur content in English coal was 2 p.ct., American coal contained about 1 p.ct. or slightly under. The American coal delivered to British gas-works during the coal strike averaged 0·9 p.ct. Possibly the higher sulphur content in the gas treated in this country would to some extent nullify the advantages to be gained by the liquid processes, except perhaps the last one, which the author referred to, but was very guarded about, because he had said that no particulars had yet appeared in the Press. With regard to dehydration, the industry were indebted to Messrs. W. C. Holmes & Co., for having developed their process. In connection with the "Connersville" meter, it was interesting to know that a remark was passed at a recent meeting reported in the Technical Press that very slight deposition of naphthalene was sufficient to cause the meter to cease to function. Therefore, it appeared that, to work with the "Connersville" meter, it was essential to adopt naphthalene washing. This brought him to the question of the works where only verticals were in use. The amount of naphthalene in vertical gas was notoriously low, but if a very slight deposition of naphthalene was likely to cause the "Connersville" meter to cease to function, then it was possible that, though there might not be deposition of naphthalene from vertical gas, there might be a deposition of gumminess, which would also cause the meter to cease to function. Had the author heard of any case in which a meter had behaved in that way in those circumstances?

THE "CONNERSVILLE" METER.

Mr. J. H. GOLDSMITH (South Suburban Gas Company) expressed his interest in the comparison between the washer-cooler and the horizontal water tube condenser given in the paper, and suggested that the author had rather under-estimated one or two advantages of the washer-cooler, one of the objects of which must be to clean the gas to a higher degree than was possible with the horizontal tube condenser. It would be interesting to hear a little more on that point. The author mentioned that 4 H.P. was required in both instances to pump 310,000 gallons of water per day in the case of the washer-cooler, and 190,000 gallons of water per day in the case of the hori-

zontal tube condenser; and this lower figure for the horizontal tube condenser made the comparison more in its favour. In Table II., comparing the characteristics of the "Connersville" high-pressure booster, the efficiencies given related to adiabatic compression, and mention was also made of Mr. Lacey's figures in the "JOURNAL" for June 20 last year. Mr. Lacey's figures of 45 to 60 p.ct. related to isothermal compression of the gas; and it was on the isothermal basis that it was usual to work in this country. Could the author give the comparison in Table III. on the isothermal basis, and not on the adiabatic compression basis, because this would make a considerable difference in some cases. Mention had been made of a pressure of 10 lbs. for the "Connersville" type of booster, but could it be used up to 30 lbs. or even 60 lbs. per sq. in.? The President had mentioned this type of meter gumming up with a slight amount of naphthalene. He himself, however, had had such a meter under observation for 2½ years, and had not experienced that trouble. It was working on crude water gas, and at the commencement there was a slight amount of slip, about ¾ p.ct. After the meter had been working for some time, however, the amount of slip became immeasurable. There seemed to be a slight coating of dirt on the impellers which had taken up the small clearance, but it did not seem to have made any appreciable difference to the back-pressure of the machine, which was working at the same back-pressure now as when it was originally installed. In view of the remarks of the President as to a small amount of gum stopping the meter, these facts might be interesting.

Mr. T. CAMPBELL FINLAYSON (Woodall-Duckham Companies) said that in Table I. the author described three typical coke oven installations; but he had made use of a phrase which might be slightly misleading in this country—namely, the direct system of ammonia recovery. This was the American phrase for the direct system, but the same system in this country was known as the semi-direct; the difference being that in the process used in America the virgin liquor was condensed out in direct water-tube condensers, the gas passing through tar extractors, through a re-heater, and then through the saturator. In England, in the so-called direct process the gas which was still laden with tar went through the saturator without any preliminary cooling or removal of the water vapour; and the claim for the semi-direct process was that it prevented the passage of a certain amount of tar into the saturator. Table I. had another interesting feature as regards coke ovens—namely, the high calorific value of the gas being made. In this country for a long time the view was held by the gas industry that coke ovens could not produce consistently high calorific value gas, but it might be of some interest to know that in Sheffield the Gas Company were now getting every day 3½ to 4 million c.ft. of coke oven gas of a calorific value of 550 B.Th.U. gross, and that this calorific value was with de-benzolized gas. The table of calculations of washers and coolers was extremely interesting, and related to a matter which they should seriously consider, because it seemed to afford a justification for their ideas on this side in regard to horizontal tube indirect coolers. The dephenolating process described in the paper was undoubtedly one of the most successful—if not the most successful—process for removing the phenols; but they must keep in mind that the problems of effluent disposal in this country and America were very different. In America the actual disposal of the effluent, *per se*, was not the problem. The real problem was the fact that the monohydric phenols caused the water to taste. In this country the measure of objection to the effluent was the oxygen absorption factor, which did not depend only on the phenols. It depended on the other compounds such as the thiocyanates and thiosulphates; and whereas the dephenolating process undoubtedly improved the quality of the effluent, it unfortunately did not entirely eliminate the objectionable constituents from the effluent. The process, however, was a step in the right direction, though it was not a solution to all the difficulties. With regard to liquid purification, and the surprise expressed by the President that these processes had not been developed in this country, it might be well to make the position clear. Some six years ago Sir Arthur Duckham was in America to obtain for his Companies licences for the liquid purification processes existing and future, as developed by the Koppers Company, and since that time the research staff in America and the research staff on this side had been in collaboration as to the process, and they in this country had also been in touch with the authorities who had to determine whether any new process was allowable under the Alkali Acts, and also with certain technical staffs of undertakings here in order to see whether any process which had been developed in America would be suitable for English conditions. For various reasons, right up to the introduction of the most recent process, the "Thylox" process, the decision had been come to that for a number of reasons liquid purification could not compete successfully with oxide purification, which was an extremely reliable process; and any new process must not only be equally reliable but even show one or two advantages. With such a system as the "Ferrox," when one was speaking to engineers having the disposal of thousands of gallons per day, and had to tell them that at the end they would get a result not very much better than that obtained with the oxide process, and in addition that they would not get 100 p.ct. removal—and, moreover, that they would have to put in oxide boxes as well—it did not appear a very attractive proposition. However, as the author had said, the new process did hold certain interesting possibilities. In this particular process the sulphur came out in a pure form, the effluents were very much less, and the costs of operation appeared to be lower; and it should be stated that it was being most carefully considered. When it was felt that there was a process which could stand in competition with the well-established methods of solid purification, every endeavour would be made to put it before engineers. The "Connersville" meter was a development which seemed likely to have a large application in this country, and generally to have a great future. There were two questions he would like to ask concerning it. Was it true that small "Connersville" meters were now being used to check up wet meters? He had heard rumours that this was so. The second question was more serious. Supposing he put in a 200,000 c.ft. per hour "Connersville" meter, and some day wanted to test that meter, he did not think he could use an ordinary 100-light meter for the purpose, because he understood that if the load fell below a certain figure there was a big proportion of slip. Therefore, how could a 200,000 c.ft. "Connersville" meter be tested?

Mr. T. MCSWEENEY (South Metropolitan Gas Company) asked for further details of the producer mentioned in Table I. which was successfully gasifying small coke and apparently also breeze. In addition, would the author give some idea of the coke quenching and cooling methods adopted in America?

Mr. ROY SUMMERSON (Luton Gas Company) suggested that the paper would have been more interesting if the author had included a statement of working results of a typical American gas undertaking. This would give interesting information as to capital expenditure and wages costs, and show if the ratio was very different in the American industry as compared with their own. He would also like to know the average income of the American gasworker, because it was rather ironical that gasworkers could not afford all-gas houses in this country. If the American industry paid its workers well enough to enable them to enjoy that privilege, it would suggest that the American industry had been rather more successful than their own. In Table I. three kinds of coke were mentioned. Could the author give a more technical definition as to the exact difference between these cokes, and how they were produced? It was stated that the period of coking for blast furnace and domestic coke was 13½ hours, while the period for foundry coke was 20 hours. Was this for the same charge, or was the charge of foundry coke heavier? Had the author any information as to the type of retort house governor, if any, in use in America? It was to be hoped that they did not employ the ordinary type. As to the washer cooler, it occurred to him that the considerable circulation of the liquor would increase the toxic effects of the effluent liquors from the sulphate plants; and therefore he did not think they should encourage that method in this country. The author stated that there was a lower reduction of calorific value in the tower scrubber; but if each apparatus extracted an equal quantity of naphthalene, there should be an equal reduction in the calorific value, and therefore one plant could not claim an advantage over another unless the extraction efficiency was greater If there was the gradual accumulation of naphthalene deposits in the "Connersville" meters, surely it would to some extent affect the accuracy, inasmuch as it increased the slip?

OXIDE PURIFICATION IN THE UNITED STATES.

Mr. A. G. GRANT (Gas Light and Coke Company) remarked that the author had not said a great deal about oxide purification. This country had led the way in this until recent years, though America had since studied it intensively, and, he believed, adopted somewhat different methods, using very deep purifiers having high back-pressure and a high capacity. Did the author consider the American methods were superior? Did they get more out of their boxes, and was the resulting cost of purification less? As regards liquid purification processes as applied to water gas plants, the original H_2S content of the gas was very much lower than in the case of coal gas; and this seemed to be the criterion in the matter. Finally, with regard to naphthalene washing, two American types of washer had been described in the paper, but surely the British type of multiple bay washer working strictly on the counter-current principle was more efficient and economical?

Mr. C. C. CLACK (Tottenham and District Gas Company) said that after many years of distributing wet gas, it seemed to him that, by introducing dry gas distribution, there was the danger of drying the moisture from the wet rust in the meters, and for particles of the dried rust to float about in the gas and give trouble in the inside fittings. Similarly, there might be trouble with this dry debris in the meters.

Mr. R. J. PEPPER (Gas Light and Coke Company) said that apparently there was a very large amount of coke consumed in America—about double the quantity used here. How did the American companies sell it, and how were the sales increased so largely in comparison with those in this country, where they were still debating the advantages of solid smokeless fuel? He was wondering particularly as to the attitude of the local authorities, and whether there were laws governing smoke abatement which prevented the use of coal for domestic purposes. It appeared that carbonization in America was regulated by the demand for coke.

Mr. D. CLEAVE CROSS (Lea Bridge District Gas Company) remarked that it was surprising to hear that in a large country like America gas undertakings should experience difficulties for want of ground space. As far as condensation was concerned, Britain certainly led the way. There were two principles which had been developed in America which they in England were now copying. One was the "Connersville" meter, which was no doubt coming to the fore in this country in preference to the large meter, because of the saving of space. Wherever it had been adopted in England good reports had been heard of it, which should give the gas engineers in this country sufficient confidence to adopt it. The question of the checking of the meter, however, which had been mentioned, was a very important point. While it was possible easily to check a wet meter, they could not very well check a meter which had slip. Another direction in which America had led them was in regard to the tankless gasholder, which was now being favoured in England. Could the author say what was the effect in America of acute cold weather on the tankless holder? The point had been raised in connection with the cold spell in this country a short time ago. Were the Americans experiencing sticking-up of the disc through the tar getting thick or the water in the tar turning into ice? Some information on this point would be interesting. One big difference in American carbonizing systems apparently was that they went out for coke, whereas in this country they concentrated more on gas. The Americans blended their coal very carefully, and paid great attention to coke quality. On the other hand, in this country there were gas undertakings using coal with 12 p.ct. of ash, and sending out coke

with 20 p.ct. of water. When one tried to sell good coke, the price of this cheap coke had to be faced; and it really became questionable whether one got credit for making a really good coke in this country. It was here, he thought, that the "Coalite" people would get into trouble in years to come, because in comparing their coke with (say) that from some gas undertakings, and endeavouring to get 10s. to 15s. per ton more for it, they would be faced with competition of poor quality cheap coke; and if the price of "Coalite" dropped, it would be difficult to make the low-temperature carbonization process pay.

The "Seaboard" Process.

Mr. T. H. Prater (Isle of Thanet Gas Company) asked whether condensation in America was always carried out before the exhauster. With regard to the purification from H_2S by the "Seaboard" process, it occurred to him that the objection to that process mentioned by the author—namely, that the H_2S passed into the atmosphere—might be obviated by the combustion of the H_2S, and the washing-out of the resulting SO_2, as was effected in the purification process attached to some sulphate plants. Would the author elaborate a little on the use of the "Connersville" blower in connection with water gas plants? He did not think the "Connersville" blower was working anywhere in England; and it would be interesting to hear a little more about it. The range of accuracy of the "Connersville" meter was remarkable, and it commended the meter to engineers, apart from the reduced amount of space occupied. Further, the use of this meter for crude gas was fascinating. It was difficult to measure water gas passing into a foul main, and there mixing with coal gas; and the "Connersville" meter seemed to overcome this difficulty. With regard to dry gas, there was the point that dehydration might well be worked with one of the American systems of gas storage mentioned by Mr. Milbourne in his recent paper. There was a considerable future for the spherical gasholder, though there was the question of the reduction in pressure. If they could be assured that this was technically satisfactory, there seemed to be little against the spherical holder.

The Author's Reply.

Mr. Watson, replying to the discussion, said that the "Connersville" exhauster was designed to run at 250 to 300 r.p.m. at normal load, and it would be coupled to a vertical steam engine designed for running at that speed, so that neither unit would be working outside its rated speed. With regard to the "Thylox" process and its application to British gas practice, Mr. Finlayson had answered this in stating that liquid purification was being considered for application to British conditions at the present time. As to the "Connersville" meter ceasing to function, due to naphthalene deposits, this had been only a temporary discontinuance, and had not been experienced elsewhere.

Mr. Goldsmith had referred to the washer-cooler as a fairly effective tar extractor, but he was not aware that this claim had been widely substantiated; and it was therefore customary in America to supplement the washer-cooler with a bubbling apparatus similar to a Livesey washer or a "P. & A." tar extractor. The reason that the power consumption was the same though less water was circulated in the horizontal tube condenser than in the washer-cooler, as shown in Table II., was due to the fact that different pressure heads had been taken. In the washer-cooler it was necessary only to lift the cooling water to a head of 20 ft., whereas in the usual type of horizontal tube condenser the head was 30 ft. or 40 ft., or even greater. The limit of usefulness for "Connersville" boosters was given as 12 lbs. per sq. in. They were not considered to be efficient machines over that pressure, because the slip then became considerable in proportion to the amount of gas put through; and as the volumetric efficiency fell away, the over-all efficiency naturally was reduced also. Therefore 12 lbs., corresponding to an efficiency of 60 p.ct., was taken as the limit of usefulness. As to the comparison between adiabatic and isothermal compression, he had not had an opportunity of working the figures out, but he thought that up to 10 lbs. pressure the difference between the two would hardly affect the figures given.

It was definitely the case, as mentioned by Mr. Finlayson, that small "Connersville" meters were being used to check wet station meters. These were small meters capable of passing about 7000 c.ft. per hour which normally could be overloaded up to 100 p.ct., and were mounted on small wagons, and moved about the works. They were connected by means of flexible pipes, such as rubber hose, and were used for proving large station meters at the rate of about 10,000 c.ft. per hour; the station meters having a capacity of 200,000 c.ft. per hour. In considering the design of the meter, it must be borne in mind that the casing was made of cast iron, and its dimensions were more or less unchangeable. The impellers were rigid, and the volumetric capacity of the meter could be regarded as (say) 99·25 p.ct. unchangeable. This was a rough figure, but showed that the only variable was the slip. This could be checked by rotating the impellers with the valves at the inlet and outlet of the meter closed; the impellers being rotated to give a definite differential. Another method of checking the slip was by passing gas through the meter, when it was standing stationary, at a rate to give a definite differential. In other words, the impellers were held stationary, and sufficient gas was passed through to register (say) half-an-inch of water gauge pressure drop across the meter. This represented the slip, and could be tested at any time. The major part of the measurement was definite up to about 0·75 p.ct. which was slip and could be checked *in situ* on the meter by the foregoing methods. He was afraid he had not the details asked for of the producers gasifying coke breeze. They were, however, probably 12 ft. in diameter, and they would have a fuel bed of about 6 ft. They were gasifying coke breeze with a steam saturation in the blast corresponding to about 50° C. He would, however, be pleased to provide further information later. As to the method of coke handling, the coke was pushed from the retort into a quenching car, which took it to a central quenching tower, after which it was returned and discharged on to the screens before being dispatched.

As to the information of the accounts of a typical American gas undertaking, it had not been possible for him to get this while he was in America, but there was a lot of very useful information of that nature in the Proceedings of the American Gas Association. The wages of the average American gasworker were in the neighbourhood of 62 cents to $1.00 per hour. Concerning the differences between the characteristics of the various cokes, the main characteristics were that the domestic coke could be more or less classified with blast furnace coke in that it was a hard and dense coke. Carburetted water gas coke was slightly more porous, and was made by blending coals so that there was a larger proportion of volatile coal used, giving a more porous coke. The foundry cokes were made by blending medium-volatile coals with high-volatile coals in the proportion of about 70 p.ct. high-volatile coal and 30 p.ct. low-volatile coal; and the hard coke was presumably produced by the longer period of carbonizing. The type of governor installed was usually the "Shallcross" or similar type.

It had been suggested by Mr. Summerson that there should not be a claim made on account of lower reduction of calorific value of the gas treated in the tower scrubber as compared with the immersion washer, and that if the same amount of naphthalene was extracted there should be no reduction in calorific value. The point, however, was that in the immersion type of washer 240 gallons were used per million c.ft., whereas with the tower scrubber only 30 gallons were used per million c.ft.; the oil being saturated with benzole and light oils. Therefore, naturally in the case of 240 gallons per million there was the removal of more light oils than in the case of 30 gallons per million; hence the greater reduction in calorific value. He had not any figures with regard to cost of oxide purification. He agreed with Mr. Grant that probably the system of multiple bays on the principle of counter-current washing for naphthalene extraction was preferable to either the immersion washer or the tower scrubber. There was no pumping, and less horse-power was required. There was merely a consumption of 3 h.p. for turning the washer round; and the amount of oil handled was the absolute minimum.

The question of whether trouble had been experienced through dust passing forward with the gas in the case of dehydrated gas had been raised by Mr. Clack. In America, where a high calorific value was maintained and a considerable amount of water gas was sent out, there was always a certain amount of condensation of oil fog in the mains, which formed a film over the rust and therefore prevented it being carried forward. It had been found that the same effect could be obtained in this country by spraying the mains periodically with oil; and where gas dehydrating plants were installed it was recommended that before these were started up the mains should be sprayed, and that this should be done at fairly frequent intervals, though not continuously, in order that no rust should be carried forward by the gas. In reply to Mr. Pepper as to the sale of coke in America, this was done through the ordinary organizations, such as sales centres and showrooms in the towns, &c. The chief point was that the American consumer had been educated over a long period to burn anthracite, when anthracite was cheap. Most houses were fitted with closed stoves and central heating arrangements for burning anthracite; and now that anthracite was dearer, coke was the next best and cheapest substitute, and it burned as well as anthracite. He did not know of any smoke abatement laws in the United States; it was rather that American households had been used to burning smokeless fuel, and were equipped for it.

As to Mr. Cross's question concerning the working of waterless holders in cold weather, the latest practice in America appeared to be to instal a tar dehydrator in conjunction with a waterless gasholder. The tar was taken from the seal of the holder and pumped through the tar dehydrator, and the light oils and water were removed; the dehydrated tar being then returned to the seal, afterwards going through the normal process of being pumped back to the top of the piston. In this way, particularly in Toronto, any trouble from ice forming above the piston had been eliminated.

The question had been raised whether condensation was carried out before the exhauster. There were several undertakings that practised both primary condensation followed by exhausters, and then secondary condensation, much as they did in several London works. With regard to compression before the holders, and its application in England, particularly with respect to dehydration, he thought the figures in the paper showed fairly definitely that, unless it was desired to compress the gas to 30 lbs. for distribution, compression could not be regarded as an economical method of dehydration. For undertakings that would consider the distribution of gas at 30 lbs. pressure, no doubt it would be advantageous to put in after-coolers to obtain the benefits of dehydration after the gas was re-expanded.

Vote of Thanks.

On the motion of Mr. T. H. Prater, seconded by Mr. A. W. Mayo (North Middlesex Gas Company), a hearty vote of thanks was accorded the author.

Mr. Watson acknowledged the vote.

Damage of Vegetation by Smoke.—Prof. Noack and his collaborators have recently investigated the action of sulphur dioxide, nitrous gases, ammonia, and hydrogen chloride on vegetation (Z. angew. Chem., Feb. 2). Both qualitatively and quantitatively the effect is the same in each case, consisting of a poisoning of the assimilation mechanism in the plant. The poison probably attacks the iron compound which normally catalyzes the assimilation process, and treatment of poisoned plants with iron-containing solutions was found in some cases to have a restoring action. Doses of poison too small to be toxic actually had a stimulating effect on assimilation.

LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION

A Meeting of the Association was held in the Westminster Technical Institute, London, on Friday, March 22—Mr. W. T. KENSHOLE (President) in the Chair.

THE INSTITUTION EDUCATION SCHEME.

A short discussion took place upon the Institution Education Scheme, Mr. T. H. PRATER (Isle of Thanet Gas Company) reading the report which has been drawn up by the representatives on the South-Eastern Education Committee of the Institution of Gas Engineers, referred to on p. 795 of the "JOURNAL" for March 20. The object was, as the PRESIDENT explained, to obtain some expressions of opinions upon the report, to see if the members of the London and Southern District Junior Association were in agreement with what has been drawn up.

Mr. PRATER, having read the report, said this had been considered at a meeting of the Southern Association of Gas Engineers and Managers (see "JOURNAL" for March 20, p. 793), when the resolution embodied in the report was endorsed; and it was hoped that similar support would be forthcoming from the Juniors.

Mr. J. H. GOLDSMITH (South Suburban Gas Company) moved the adoption of the report, and Mr. W. J. BRAND (Lea Bridge District Gas Company) seconded.

The PRESIDENT put the resolution for the adoption of the report to the meeting, and it was carried unanimously.

Mr. C. W. M. ROGERS (Gas Light and Coke Company), referring to the question of percentage of attendances at the classes on the part of those taking part in the Education Scheme, said it was sometimes very difficult to put in the number specified. It seemed to him that, if one could pass the examination, this was sufficient guarantee that one knew the work. There was no mention of this difficulty in any of the criticisms he had seen of the scheme.

Mr. PRATER said the report had been prepared in December last, and the point just mentioned had been considered. If the suggestions which had been put forward in regard to the scheme, that the Institution should be the examining body only, were accepted, the objection raised by Mr. Rogers would be met, because compulsory attendance at the classes would not then apply. The suggestion that as long as the person passed the examination this should be sufficient, was the point which had to be guarded against; and it had been suggested that the higher examination should be an oral examination, as in the case of the Diploma, to protect the Institution from those individuals who might be able to pass a written examination, but who were not sufficiently acquainted with the work to merit the distinction it was desired the examination should give.

AMERICAN GAS PRACTICE.

A paper on "Observations of American Gas Engineering Practice" was then presented by Mr. S. G. WATSON, M.Sc., of Messrs. W. C. Holmes & Co., Ltd. The major portion of this contribution was published in the "JOURNAL" for March 27 and April 3. The remainder, together with the discussion, will be found in our issue to-day.

SOUTH METROPOLITAN GAS COMPANY.

Some Facts and Figures.

[From the Company's Co-Partnership Journal for March.]

The South Metropolitan Gas Company was formed in 1829, just one hundred years ago, and commenced the manufacture of gas at the Old Kent Road Works in 1833. It was incorporated by Special Act of Parliament on June 18, 1842, with a capital of £200,000. The coal carbonized at that time was about 7000 tons yearly. In 1879 it amalgamated with the Surrey Consumers' Gas Company, whose works were situated at Rotherhithe. In the following year the amalgamation with the Phœnix Gas Company took place, by which arrangement the works at Bankside, Vauxhall, and Thames Street were taken over; while in 1885 works at West Woolwich (now demolished) were acquired through amalgamation with the Woolwich, Plumstead, and Charlton Consumers' Gas Company and the Woolwich Equitable Gas Company. In 1883 the building of the East Greenwich Works was started, and in 1887 gas-making commenced there.

To-day the Company carries on its business under powers contained in eighteen Special Acts of Parliament, three Schemes of Amalgamation, one Agreement, and many General Acts. Its capital at the end of last year was £9,739,340, while the quantity of gas made during the year was 93,106,042 therms. The capital required per therm of gas sold was 2s. 1d. The gas made necessitated the carbonization of 1,249,919 tons of coal, the greater part of which was brought from the North of England in the Company's own colliers. There are seven of these colliers, all of a similar type, and each of which has a carrying capacity of about 2200 tons. They arrive in the Thames at an average rate of over eight per week, and discharge at the East Greenwich or the Rotherhithe Works. The up-river works at Bankside, Vauxhall, and Old Kent Road receive their coal in barges which are loaded direct from steamer. The number of barges required to deal with the distribution of coal is about fifty. The quantity of coal carbonized at all the works of the Company varies from about 17,500 tons per week, or 2500 tons per day, in the summer months, to about 35,000 tons per week, or 5000 tons per day, in the winter months. From each ton of coal carbonized 74½ therms of gas, 9½ gallons of tar, and 41½ gallons of ammoniacal liquor are obtained.

The number of employees is about 9000, and the average amount of capital required to give employment to each one is therefore over £1000.

The quantity of coke made last year was 756,381 tons, or an average daily production of over 2000 tons. Of this, 152,670 tons was used as fuel in the manufacture of coal gas, and of the remainder over half was sold for industrial purposes, and the rest for domestic use and export.

The Company's area of supply is about 52 square miles, and stretches from Clapham Junction to Abbey Wood, and from Southwark to Norbury and Bromley Hill. There are 1460 miles of mains, the largest of which has a diameter of 48 in. Gas is supplied to nearly 420,000 consumers; and assuming an average of five members per family, the number of people dependent for the comfort and convenience of a gas supply from the Company is over two millions. Gas is also sent in bulk to the South Suburban Gas Company through a 36-in. main, the laying of which was completed last year.

All the tar produced at the various works of the Company, amounting to over 12,000,000 gallons, is taken by barge to the tar works at Ordnance Wharf, where it is distilled into road tar, creosote, pitch, light and heavy oils, benzole, and many other tar products. The ammoniacal liquor made, a total of 52,000,000 gallons per year, together with the spent oxide from the purification of gas, are dealt with at the chemical works at Phœnix Wharf.

There are nineteen gasholders used for the storage of gas, the largest of which is at East Greenwich. Over half the gas made by the Company is manufactured at East Greenwich, whence large quantities of gas are daily pumped via Old Kent Road to the other works of the Company for distribution in the south-western and other parts of the area of supply. The largest daily output of gas in 1928 occurred on Dec. 18, a cold, dark, foggy day, when over 405,000 therms passed through the works meters, or about $\frac{1}{250}$th of the total output of the year.

There are five company-owned and four municipally-owned electricity undertakings which supply the area served by the Company, and which carry on their business in direct competition with that of gas supply.

The total wages and salaries paid by the Company amounted last year to nearly £1,900,000.

Classification of Coal.—In a paper on "Problems in Carbonization" before a meeting of the Coke Oven Managers' Association at Newcastle-upon-Tyne recently, Dr. S. Roy Illingworth said that the classification of coal gained in importance daily by virtue of the diminution of coking coals and the conditions and variations in supply due to the spasmodic working of particular seams. Seyler's classification, in his opinion, was the keystone for the correlation of the behaviour and properties and treatment of coal. Seyler demarked the general characteristics of a coal by the amount of carbon therein, and particularized the behaviour of all coals within the limits of carbon defined by the content of hydrogen. His classification was based on the ash-free dry basis, under which conditions one was solely concerned with a coal complex. They could say that within particular carbon limits the lower the hydrogen the stronger the coke; for the hydrogen reflected the coking principle of a coal.

NEW ZEALAND GAS INSTITUTE.

Fifth Annual Conference at Wanganui—Mr. W. J. Stone, President.

[*Photo. by T. H. Whetton, Wanganui.*

PARLIAMENTARY INTELLIGENCE.

[From Our Special Correspondents.]

HOUSE OF LORDS.

Gas Undertakings Bill.

The Gas Undertakings Bill was read a third time without discussion on March 25, and sent to the Commons, where it received a formal First Reading and was put down for Second Reading on April 15. It will not, however, be taken then on account of the Budget.

Private Bills.

The Imperial Continental Gas Bill has been referred to the Unopposed Committee, which meets to consider it at 3.45 p.m. on April 16.

The Yorktown (Camberley) Gas Bill and the Wandsworth, Wimbledon, and Epsom District Gas Bill have been read a third time and sent to the Commons.

The Royal Assent has been given to the Sheffield Gas (Consolidation) Bill.

The Romford Gas Bill has been referred to a Select Committee, which meets at 11 a.m. on April 16, but it is not likely to be taken then, as there are three other Bills in front of it.

The Gas Light and Coke Company's Bill, having passed the Commons, has been read a first time in the Lords, and referred to the Examiners.

The Southport Gas Order has been referred to the Special Orders Committee. The Barnard Castle Gas Order is awaiting Affirmative Resolution after having passed the Committee.

The Gas Light and Coke Company have deposited a Petition against the Westminster City (Millbank) Improvement Bill.

HOUSE OF COMMONS.

Private Bills.

The Newcastle-upon-Tyne and Gateshead Gas Bill and the Gas Light and Coke Company's Bill were read a third time and sent to the House of Lords.

The Winchester Water and Gas Bill was reported with amendments from the Committee.

GAS-MANTLE INDUSTRY.

Employment.

Sir HENRY JACKSON asked the President of the Board of Trade whether he could state the average number of workpeople employed per week in the gas-mantle industry during the last quarter of 1924 and the last quarter of 1928 respectively.

Mr. H. WILLIAMS replied that, from the information supplied by the manufacturers, it was estimated that the average number of workers employed in the gas-mantle industry during the last quarters of 1924 and 1928 were about 1900 and 2200 respectively.

Mr. BENN asked whether the gas-mantle manufacturers mentioned stated the bonus paid to the German combine.

Mr. WILLIAMS said he understood that, after the industry was safeguarded, an arrangement was made with the German manufacturers whereby the British industry had the great advantage of having no competition from Germany.

Mr. J. H. THOMAS inquired whether it was true that the combine on this side paid a fixed price per mantle to the Germans for keeping out.

Mr. WILLIAMS replied that he understood that, after the industry was safeguarded, a very satisfactory arrangement for the British industry was concluded on those lines.

Mr. BENN asked if the amount of this danegeld could be supplied.

Mr. WILLIAMS replied in the negative, as the details were not disclosed.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

The "Congdon" System.

SIR,—The paper on "Modern Horizontals" read by Mr. F. Blackburn at the recent meeting of the Southern Association, with the discussion following thereon (see "JOURNAL" for March 27, p. 857), will have been perused with great interest by the many gas engineers faced with the problem of extending or modernizing their carbonizing plant.

In the discussion, frequent reference was made to the "Congdon" system. Having been a user of this system for the past eighteen months, I find it rather difficult to follow the several speakers in referring to their experiences when operating that system. The difficulties related might be summarized as follows: (*a*) Offtake valves not gas-tight; (*b*) rapid destruction of wrought-iron and steel parts of the valve mechanism by hot liquor; (*c*) thick tar and pitch in seal pots and separating pits; (*d*) expansion of the setting causing dislocation of the gas offtake system.

Possibly these troubles were experienced with the earliest installations of the "Congdon" system in this country. Had the speakers the good fortune to operate a modern example, I am sure that they would have had quite a different story to relate.

Actual experience with the "Congdon" system over the before-mentioned period has convinced me that, with ordinary care, the offtake valves remain quite gas-tight. A close examination of the valves and mechanism fails to reveal any destructive action by the hot liquor. Deposits of thick tar or pitch in the separating tanks are unknown. The small accumulation of pitch and free carbon that collects in the seal pots is cleared out once in 24 hours. The contents of eight seal pots usually barely fills an ordinary 2-gall. pail.

Finally, the most important matter of expansion is ingeniously provided for, and is allowed to take place without in any way disturbing the gas offtake system.

I hope this statement will enable the readers of the "JOURNAL" to acknowledge that the "Congdon" system can claim and hold its position in the equipment of a modern horizontal retort house.

H. R. WIMHURST,
Engineer and Manager.

Bury St. Edmunds Gas Company,
Bury St. Edmunds, April 4, 1929.

MISCELLANEOUS NEWS.

COUNCIL HOUSES AT COLCHESTER.

Applications for Gas Lighting Refused by Town Council.

The following circular letter has been addressed by the Secretary of the Colchester Gas Company to each member of the Colchester Town Council:

Dear Sir or Madam,—At a meeting of the Whitley Council for the Gas Industry, representing both employers and workmen, held on March 13, 1928, the following resolution was passed:

> This Council views with concern the fact that in certain cases local authorities, by inserting conditions in leases and in other ways, have interfered with the liberty of and choice of their tenants in determining what forms of light, heat, and power they will use in their houses, and considers that all tenants of council houses should be free to use whatever form of lighting, heating, &c., they may desire. The Council, therefore, urges the Minister of Health to take the steps necessary to prohibit local authorities from imposing in any way any condition or restriction with regard to the form of light, heat, and power to be used in any house, shop, office, or other building owned or controlled by them, or with regard to the taking from any particular local authority, company, body, or person of any form of light, heat, or power.

We venture to draw your attention to the above resolution, because the Colchester Town Council is one of those which refuse permission to the tenants of Council houses to use gas for lighting, as you will see from the attached copies of letters (*a*) from the Town Clerk to the Company; and (*b*) from the Borough Surveyor to the tenant of a Council house.

In most of the Council houses provision has been made by the Council for the use of electric light, and gas is used for cooking, and in some cases for wash boilers. It is realized that the Council is within its rights in installing one system of lighting when building the houses, and that it should not be put to the expense of providing a dual system. In many cases, however, the tenants desire to use gas for lighting, and the Company is willing to instal the necessary pipes and to supply the fittings without charge, the rental of same being covered by the money placed in the "penny-in-the-slot meter."

In such cases the Council would be put to no expense if permission were granted to the tenant to use gas for lighting if he desires; but such permission has been persistently refused.

It is our experience that people of moderate means value gas lighting for several reasons, among others the quality and reliability of the light, and the fact that this source of illumination also provides heat, which is very welcome in bedrooms and similar apartments; and the question of cost is also important, especially the cost of renewing a gas mantle compared with an electric bulb. It has been suggested that as landlords the Council object to gas lights being installed for two reasons: (1) The damage caused to the building and decorations in fitting the pipes; and (2) blackening of ceilings.

With regard to the first, the Company is prepared to make good just as in the case of private owners of property. With regard to the second, we understand that the Council places no restrictions on the use of smoke-emitting oil lamps in Council houses, and that these are frequently used. As to the question of decoration, it is probably necessary for hygienic reasons to whiten the ceilings periodically, and it has been shown that the use of gas for lighting purposes has a definite hygienic value in burning up germs and causing an upward current of air, which assists ventilation; and it is dirt which is found on the ceilings, and not something arising from the combustion of the gas.

Finally, we suggest that the tenants of the Council houses should have free choice as to which illuminant they should use, and it is extremely unfair to the Gas Company, as large ratepayers and as local employers of labour, that they should be debarred from supplying customers who desire to use gas for lighting. During the five years 1924-28 the Colchester Gas Company paid the Colchester Town Council £15,288 5s. 2d. in rates, and £910 18s. 1d. in river dues. In 1928 the amount paid for rates alone was £3121 2s. 11d.

The letters from the Town Clerk and Borough Surveyor referred to above were as follows:

Town Clerk's Office, Town Hall, Colchester,
March 8, 1929.

Dear Sir,—Your letter of the 3rd ultimo was placed before the Housing Committee at their last meeting, and full consideration was given.

The Committee do not, however, deem it needful to depart from their present practice of having electricity installed for lighting and gas for cooking purposes.

Faithfully yours,
(Signed) H. C. Wanklyn.

W. W. Townsend, Esq.,
Engineer and Manager, Colchester Gas Company, Colchester.

Borough Engineer's and Surveyor's Office,
Town Hall, Colchester,
Feb. 6, 1929.

Mrs. ———
Council Houses, Old Heath, Colchester.

Dear Madam,—Referring to your call at my office this week asking for the gas service to be substituted in place of the electric, I beg to say that the Council will not allow this.

If you desire to have a shilling slot meter installed in place of receiving a quarterly bill for current supplied, I would advise you to make application to the Electricity Department, in Osborne Street.

Yours faithfully,
(Signed) Harold Collins.

GAS COMPANIES' RESULTS IN 1928.

DARTMOUTH.

The profit of the Dartmouth Gas, Coke, and Coal Company on the year's working (after charging to revenue all renewals, repairs, and maintenance, and depreciation on meters, stoves, and gasholders) is £2303. After charging £280 interest on mortgage debentures and £70 interest on the first preference shares, and £150 for income-tax, there remains a balance, subject to income-tax, available for distribution, of £2413. The Directors recommend the full dividend of 5 p.ct. on the second preference shares, *less* income-tax, absorbing £150, and a dividend of 12 p.ct. on the ordinary shares, *less* income-tax, absorbing £912, and purpose carrying the sum of £500 to the general reserve fund account, leaving a balance to be carried to the next account of £851.

LEAMINGTON.

The 128th Ordinary General Meeting of the shareholders of the Leamington Priors Gas Company was held at the Gas-Works on Tuesday, March 26; the Chairman, Dr. Harold Mason, J.P., presiding. In dealing with the report and accounts, Dr. Mason said that in view of the mildness of the weather until after the New Year the slight increase in the output of gas might be considered satisfactory. That it was not accompanied by a corresponding increase in revenue was explained by the average price of gas having been lower in 1928—during the Michaelmas quarter of 1927 the ordinary price was 4s., being reduced to 3s. 6d. in October, 1927. The contractors for the new retort house, West's Gas Improvement Company, Manchester, had carried out their contract satisfactorily. The whole cost of the installation had now been brought in as an asset in the balance-sheet. This was, primarily, a replacement of the previous system, and, to that extent, was a proper charge against revenue. It was proposed to meet this charge by means of the renewals fund, which had been built up out of revenue; and a further £5000 had been set aside to this fund during the half-year. The income from coke was down, prices having been lower, but the revenue from tar was up, not on account of any increase in price, but because of the increased quantity sold for use on the roads.

LUTON.

The 142nd Ordinary General Meeting of the Luton Gas Company was held on Tuesday, March 26; Mr. F. W. Plummer presiding. The Directors' report for the year was as follows: The quantity of gas sold during the year was 3,313,439 therms (676,212,100 c.ft.), an increase on the sale for 1927 of 7239 therms (1,477,500 c.ft.), or 22 p.ct. The demand for gas has been well maintained, taking into account the depression in the local trades during the year, and also the mild weather experienced. The number of consumers increased by 742. The total income on revenue account amounts to £176,164, and the expenditure to £163,741, leaving a credit balance of £12,423, against £14,464 for 1927. The revenue from gas, coke, and tar is considerably lower than in 1927, owing to reduction in the price of gas and lower prices received for coke and tar, but the cost of coal has also decreased. The Chairman considered the statement of accounts and the general progress of the Company satisfactory. Not only was there an increase of 742 consumers, but 791 new cookers, 849 new fires, 111 new wash coppers, and 86 new geysers had been supplied during the year. With regard to the capital account, the Directors had adopted a system of depreciation of plant, meters, and stoves, in addition to carrying out all necessary repairs and renewals, which they considered would materially strengthen the financial position of the undertaking. New stoking machinery installed in the horizontal retort house had been working most satisfactorily since the beginning of January. During the excessively cold weather in January and February the Company sent out 7,928,000 c.ft. more gas than in January and February, 1928. Dividends for the six months to Dec. 31 last were declared as follows: Class B preference shares, 2 p.ct.; class C ditto, 2½ p.ct.; class A ordinary shares, 8¾ p.ct.; class D ditto, 7¼ p.ct.; and class F ditto, £4 7s. 6d. p.ct.

SLOUGH.

The Annual Meeting of the Slough Gas and Coke Company was held at the Offices in High Street on Tuesday, March 26, when there was a large attendance of shareholders, presided over by Mr. R. V. Elvey. The following report was presented by the Directors: The price of gas was reduced by ½d. per therm from April 1 last, and the Directors are pleased to say they have been able to make a further reduction of ½d. per therm as from Jan. 1 last. The price of gas is now the same as it was before the coal stoppage of 1926. Various new mains have been laid and extensions made during the year.

Owing to the rapid extension of the Company's business a large addition to the coal carbonizing and other plant at the works cannot be deferred. The Directors have entered into a contract for an extension to the retort house and the provision of additional purifying and other plant. These works are to be completed before next winter. An interim dividend at the rate of 7 p.c. per annum was paid for the half-year ended June 30, 1928, and the Directors now recommend a dividend at the rate of 7 p.c. per annum (*less* tax) for the half-year ended Dec. 31, 1928. In moving the adoption of the report, the Chairman said that he was pleased to state that the new mains in the Farnham Road had been completed, and they had also extended the main to Lascelles Road. They had had an extraordinary demand for gas during the very cold weather of January and February, and they had been very lucky to be able to cope with it. Sometimes the output was up by 45 p.c., while the weekly increase worked out at 22½ p.c. The Chairman paid a tribute to the splendid work of the staff in this period. Since the last meeting they had issued £18,000 worth of stock, and the fact that the tenders for this had amounted to £37,120 showed that the stock was a good investment. The adoption of the report was seconded by Mr. Dix, and carried.

METROPOLITAN GAS COMPANY OF MELBOURNE.

Half-Yearly Meeting.

The 102nd Half-Yearly Meeting of the Metropolitan Gas Company of Melbourne was held on Jan. 29; Sir JOHN GRICE, the Chairman, presiding.

The CHAIRMAN, in moving the adoption of the report and balance-sheet, said that during the half-year the coal cost £364,737, as against £378,390 for the corresponding period of 1927—a decrease of £13,653. The tonnage carbonized was 178,306, compared with 184,006 for the corresponding period of 1927, and the average cost per ton, including handling charges, was 40s. 10·91d., as against 41s. 0·39d.—a decrease of 1·48d. per ton. The revenue from the sales of gas for the half-year—namely, £749,068—showed an increase of £37,293 over the corresponding period of 1927. For the full year of 1928 the gas sold was 4,156,151,000 c.ft., compared with 4,136,881,000 c.ft. for 1927—an increase of 19,270,000 c.ft., or just under ½ p.ct. The quantity of coke and breeze sold in the half-year was less by 6884 tons, but a change in the manufacturing operations involved a greater use of about this quantity of coke at the works, which resulted, however, in an improved make of gas per ton of coal. About the same quantity of tar—approximately 2 million gallons—was sold during the half-year. The make of sulphate was lower than for the corresponding period of 1927. The demand for neutral sulphate was so insistent that special plant was installed last year to neutralize the acid and so prevent the sulphate from caking and causing trouble, both in handling and application to the earth through drills. For concentrated ammoniacal liquor, there was a steady demand—265,337 gallons being sold, as compared with 171,916 gallons for the December half of 1927.

Summing up in regard to residuals, the Company was, and always would be, subject to keen competition in the sale of these, and while in the year 1926 £337,800 was derived from residuals, only £273,300 was received from this source in 1928.

The profits for the half-year were £121,457. Of this amount, £25,562 had to be transferred to capital account to provide for the balance which remained in the books to the debit of the inclined retort house, which was now demolished. After this writing off, the profit for the half-year stood at £95,895. As the dividend at the rate of 7s. 6d. per share amounted to £97,500, the carry forward was reduced from £62,865 to £61,260.

The number of meters standing fixed at Dec. 31 was 187,273, compared with 185,465 at June 30, 1928—an increase for the half-year of 1808. The number of meters installed for the full year was 3812, as compared with 5932 during the year 1927. During the half-year nearly sixteen miles of mains were laid, and 41 miles of consumers' service piping were connected. The unaccounted-for gas had been reduced from 14·1 p.ct. in the year 1927 to 13 p.ct. in the year 1928—a reduction of 1·1 p.ct. No less than 253 industrial appliances were disposed of during the half-year.

Continued success attended the work done by the Home Service Department; 1400 homes during the half-year having been visited, and where necessary instruction in the use of a gas cooker and appliances given. Afternoon cookery demonstrations had been regularly held every Wednesday at the Head Office, and these had been largely patronized. In addition, weekly lecturettes had been broadcast through station 3LO every Tuesday morning—a service which had been much appreciated judging from the number of letters received from listeners-in. Evening demonstrations were also held in various suburban centres, the attendance in some instances reaching as high as 300.

GAS REGULATION ACT APPLICATIONS.

SPECIAL ORDER.

Horley District Gas Company.

To empower the Company to raise additional capital; to make provision for varying the periods in respect of which rates of dividend may be calculated, and to allow the Company to pay excess dividends in certain circumstances; to authorize the Company to establish profit-sharing and co-partnership schemes and to issue capital for the purposes thereof, and to grant pensions and make other allowances; and for other purposes.

PROGRESS OF THE GLENBOIG PLANT.

Now Nearing Completion.

From an article appearing recently in the "Glasgow Herald" it would seem that the plant at Glenboig (see "JOURNAL" for March 20, p. 814) is now rapidly approaching completion. It is claimed that by the process to be adopted low-grade bituminous coal, cannel coal, and mine refuse may be converted into smokeless fuel of satisfactory quality.

The plant at Glenboig, which comprises 14 furnaces, with power house, storage tanks, and other equipment, is being erected by the Bussey Coal Distillation Company, Ltd., of London. When the plant is in full operation, it will be capable of dealing with from 500 to 600 tons of coal a day. The Bussey Company, it is understood, have already made arrangements for disposing of the oil supplies to be extracted from the coal. The gas obtained from the Bussey plant is of medium calorific value, approximately equivalent thermally to commercial water gas. It is understood that when the plant is in operation a fireclay brick-making concern in the neighbourhood will take a supply of gas for heating their furnaces.

The retort used in the Bussey low-temperature process is of comparatively simple design. It consists of a steel stack lined with firebrick and supported on a concrete base. The form of the retort is that of a truncated cone of oval horizontal cross-section. The coking chamber, which is 30 ft. in height, slopes in width from 8 ft. by 3 ft. at the bottom to 2 ft. by 3 ft. at the top. The apparatus is equipped with specially designed double feed hoppers, fitted with interlocking valves operated by hydraulic cylinders on top of the retorts; and there is a similar arrangement of double discharge hoppers below.

The coming of a new industry to a district naturally gives increased employment, and already a staff of from 160 to 200 men have been employed for several months on the erection of the furnaces, power house, offices, conveyors, and other appliances. The furnaces were made in Sheffield, and most of the other portions of the plant were manufactured in England or Scotland. The total number of employees engaged by the Company when the plant is fully in operation will not be very large, as the staff will consist mainly of skilled chemists and engineers.

BUILDING TRADES EXHIBITION IN MANCHESTER.

Exhibit of Messrs. Turner Brothers Asbestos Company, Ltd.

At present a Building Trades Exhibition is being held in the City Hall, Manchester; and Messrs. Turner Brothers Asbestos Company, Ltd., of Trafford Park, Manchester, have arranged their exhibit to represent a large steeply-pitched roof, upon which are laid examples of some of the firm's many products. The lower slopes of the stand are covered with red "Trafford" tiles and grey "Turnall" asbestos-cement corrugated sheets. The "Trafford" tile has been evolved specially for the roofing of industrial buildings. Evidence of the care and thought embodied in design and manufacture is apparent. Tapered corrugations provide close-fitting lap joints. Ready-mitred corners save time and trouble in laying, and ensure an exact fit where four tiles meet at the overlap. The material employed—asbestos-cement—the method of fixing, and the centres of the purlins (*i.e.*, 3 ft. 6 in.), the absolute weather protection and the great strength of the finished roofing are all points worthy of the closest consideration. The original weather-resisting qualities of Turners' "Trafford" tiles are guaranteed for twenty years.

In response to the repeated requests of a large section of their customers, Messrs. Turner Brothers have decided to manufacture asbestos-cement corrugated sheeting. This is of the same high standard as their other specialities. Arranged for a side overlap of 1½ corrugations, equal in efficiency to two full corrugations, and made in 6-in. units up to 10 ft., these sheets possess valuable insulating qualities, keeping buildings cool in summer and warm in winter.

The upper slopes of the roof of the stand show "Turnall" asbestos-cement slates in three of the five colours available—brindled, russet-brown, and blue. These are arranged in both straight cover and diagonal methods of laying. The employment of "Turnall" asbestos-cement slates for the roofing of domestic dwellings has resulted in a definitely calculable economy; their lightness making possible lighter roof structure, and the simplicity with which they can be laid expediting erection. Their original weather-resisting qualities are guaranteed for twenty years.

An exhibit of exceptional interest is displayed for the first time in Manchester—rigid rubber floor tiles.

Bye-Products in Barbados.—The Barbados Gas Company have issued a little pamphlet advertising some of their various bye-products in the shape of disinfecting fluids, bituminous paint, wood preservatives, road tar, &c. Full particulars and prices are given, together with details of the best uses to which the products can be applied.

New Carbonization Process.—A Company known as A.B.S. Retorts, Ltd., has been formed in Sydney to take over the patent rights of a retort for the extraction of oil and various bye-products from coal, shale, and carbonaceous material. The inventor is an Australian, Mr. J. W. H. Ainscow. Maitland coal, it is stated, by this process yielded 50 galls. of oil a ton, and oil shale 100 galls.

EDUCATION IN INDUSTRY.

The programme for the Annual Conference of the Association for Education in Industry and Commerce, which takes place in London on July 2 and 3, has now been settled in outline.

The outgoing President, Lord Riddell, will instal as his successor Sir Max Bonn, K.B.E., a partner in the well-known firm of Bankers, Messrs. Bonn & Co., and Chairman of the London Advisory Council for Juvenile Employment.

The Presidential Address will be delivered on July 2, and will be followed by a luncheon given by the new President at the Savoy Hotel, at which leaders in industry and commerce are expected to be present. On the second day the conference will meet at the Polytechnic, Regent Street, when Mr. Frank Pick, Managing Director of the Underground Group of Companies, will read a paper on the "Training of Employees," and Mr. Harold Rostron, of Messrs. Tootal Broadhurst Lee Company, will present a Report on Training for Higher Positions in Commerce.

The Conference delegates will pay two visits to London works. On the first day they will be the guests of the United Glass Bottle Manufacturers, Ltd., of which firm Sir Max Bonn is Deputy-Chairman; and on the second afternoon, at the invitation of Lord Ashfield and his fellow Directors, they will study the training given to employees at the works of the Underground Group, which is so important a factor in public safety.

CEARA GAS COMPANY.

Proposed Reorganization Scheme.

The Ceara Gas Company announce that by means of a drastic reorganization of their finances there is a fair chance of enabling the Company to continue their business and ultimately retrieve their position to some extent.

It is proposed to reduce the first debentures from £25,000 to £20,000 by the payment to holders of £5000 out of moneys held in Court. Arrears of interest up to June 30, 1928, totalling £12,000, will be satisfied by the issue to first debenture holders of 10,000 ordinary shares of £1 credited as fully paid. Payment of interest will be released for two years from June 30 last.

Second debentures will be reduced from £7500 to £5000 by the cancellation of one-third of the amount of each debenture, and all arrears up to June 30 last, amounting to £4800, will be cancelled. As from that date the interest will be released for two years and the rate reduced from 8 p.ct. to 6 p.ct. As compensation, holders will receive 5250 ordinary £1 shares credited as fully paid.

Each of the 1000 first 10 p.ct. preference shares of £10 each will be written down to £6, when each share will be converted into six ordinary of £1. Each of the 942 second 10 p.ct. preference shares of £10 each will be written down to £5, and each share will be converted into five ordinary of £1.

Every issued ordinary share of £10 each, 3544 in all, will be written down to £4, and subdivided into four shares of £1 each.

The sum of £500 will be set aside annually before any dividend is paid, and applied in paying off the debentures.

Newtownards Gas Department.—The undertaking of the Gas Committee to repay £1000 per annum on the Council's overdrawn bank account has enabled the rates at Newtownards (Co. Down) to be lowered from 15s. to 14s. in the pound. The Convener of the Gas Committee, Mr. R. J. Beckett, said that the effect of the Committee's having taken the responsibility of paying off this amount would mean that there would be no reduction in the price of gas for this year at least. The Committee thought the concern should get at least a year's trial, to see if it could successfully pay off that amount each year before making any change in the price of gas.

Low-Temperature Carbonization at Doncaster.—The low-temperature carbonization plant which is to be opened next month at the Askern Main Colliery, Doncaster, owned by Messrs. Instone & Co., will be capable of carbonizing 1500 tons of raw coal per week. Their weekly output will be: "Coalite" smokeless fuel, about 1050 tons; coal oil, 30,000 galls.; motor spirit, nearly 3000 galls; and coal gas, about 6,500,000 c.ft. The retorts will be fed with raw coal hewn from the pit and with the smalls and slack recovered in the process of screening. Arrangements have already been made for the disposal of the smokeless fuel and the various bye-products. The demand for smokeless fuel is so great, it is announced, that it has been possible to make arrangements for the sale of the entire summer's output of "Coalite" from both the new Askern plant and the parent works of Low-Temperature Carbonisation, Ltd., at Barugh, Yorkshire.

Lancaster Gas Committee Estimates.—The estimates of the Lancaster Gas Committee submitted to the Lancaster Council on Friday, show that the sales of gas, *less* discounts, are expected to be £53,000; from public lighting, £3030; coke, £11,000; tar and liquor, £3200; and gas stove rents £1500; bringing the total to £73,635. On the expenditure side, it is estimated that coal will cost £29,000; purifying material, £500; salaries and wages, £3700; repairs and maintenance, £6000; oil, £200; distribution, £9700; rates, taxes, &c., £15,325; redemption of debt, £6536—a total of £71,011. Of the balance, £1500 will again go to the Borough fund, and £1124 to the reserve, to which £2455 was placed this year. Councillor Till (Chairman of the Gas Committee) hoped that the time would come when it would be illegal to apply profits on municipal undertakings towards the relief of rates. They ought to reduce the price of gas to the consumers. The estimates were approved.

TRADE NOTES.

Cast-Iron Pipes.

The Staveley Coal and Iron Company, Ltd., of Chesterfield, have just issued a new list of their cast-iron pipe specials, with full particulars of straight spigot and socket pipes, bends, collars, caps, plugs, tees, crosses, angle brackets, &c.

Apparatus for Testing Coal and Coal Gas.

Messrs. Griffin & Tatlock, Ltd., of Kingsway, W.C.2, have published a booklet (No. 105A) describing apparatus for the testing of coal and coal gas. Among the apparatus dealt with are those for testing coal mine dust, the determination of ash, volatile matter, carbon dioxide, phosphorus in ash, &c., together with various gas testing appliances, including calorimeters, barometers, hygrometers, &c.

Paxman Heavy-Fuel-Oil Engines.

Messrs. Davey, Paxman, & Co., Ltd., of Colchester and London, have issued a new and enlarged catalogue illustrating and describing their heavy fuel oil engines. The publication deals in detail with the advantages and latest developments of oil engines, and is complete with tables and sectional diagrams of many of their different models. Dealt with also are various types of steam engines, hydraulic machinery, air compressors, gas producer plants, and gas engines.

Remarkable Motor Cycle Record.

A particularly notable long-distance record has just been achieved by a 348 c.c. "Dunelt Majestic" motor cycle on the Montlhéry track, Paris. The motor cycle was one selected by the A.C.U. from a stock of similar machines (each fitted with a "B.T.H." magneto) at the manufacturers' works, and subsequently was driven day and night under A.C.U. observation for between 23 and 24 days, a distance of 25,000 miles being covered. During the run the "B.T.H." magneto made over fifty million sparks.

Extension to the Works of Messrs. Lumbys, Ltd.

Messrs. Lumbys, Ltd., Greetland Boiler Works, Halifax, the well-known makers of boilers, radiators, and other heating apparatus, are now engaged in making a further extension to the works, to meet the increased demand. New buildings and new machinery are being installed, and, it is expected, will be in operation by the end of the year. There will be no further issue of shares, as the Company's resources are sufficient for this development. The firm are makers of "Solar Steelite" sectional boilers, "Solar Doric" radiators, and "Solar" domestic boilers. In other branches, the "Royal Dreadnought" unbreakable steel sectional boilers for heavy pressures occupy an important place. Mention should also be made of the firm's "Royal Beaconstoves" for cooking and heating, which are sold at attractive prices. Three other branches—viz., riveted steam boilers, brass valves, and copper departments—have recently been extended and are now fully occupied. The quality of these goods is well known throughout the trade.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *April* 8.

There is a fair amount of inquiry for pitch for next season, and also a certain amount of buying is still being done for the current season. The price is about 35s. per ton, f.o.b. makers' works.

Creosote is steady at about 6½d. per gallon.

Tar spirits are unchanged as follows: Pure benzole, 1s. 11d. to 2s. per gallon; pure toluole, 2s. 1d. to 2s. 2d. per gallon; and 95/160 solvent naphtha, about 1s. 7d. to 1s. 8d. per gallon.

Pyridine bases is about 4s. per gallon.

Tar Products in the Provinces.

April 8.

The average prices of gas-works products during the week were: Gas-works tar, 18s. to 23s. Pitch—East Coast, 31s. 6d. to 32s. 6d. f.o.b. West Coast—Manchester, 26s. 6d. to 27s.; Liverpool, 28s. 6d. to 29s. 6d.; Clyde, 28s. 6d. to 29s. 6d. Toluole, naked, North, 1s. 7½d. to 1s. 8¼d. Coal-tar crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 3¾d. to 1s. 4¼d. Heavy naphtha, North, 1s. to 1s. 0¼d. Creosote, in bulk, North, liquid, 3¾d. to 4⅛d.; salty, 3½d. to 3⅞d.; Scotland, 3¾d. to 4⅛d. Heavy oils, in bulk, North, 6d. to 6½d. Carbolic acid, 60 p.ct., 1s. 10d. to 1s. 10½d. prompt. Naphthalene, £13 to £15; salts, £5 to £5 10s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

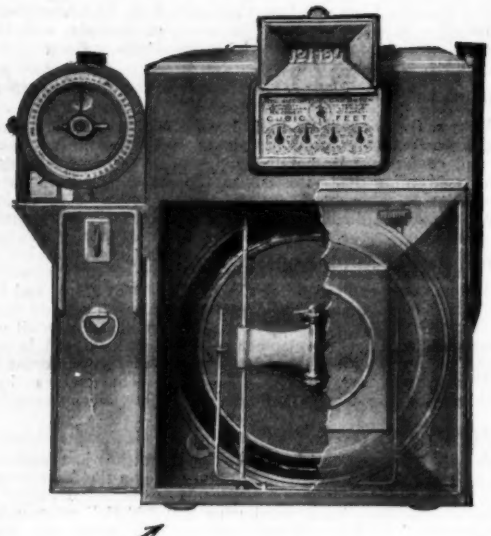
Benzole Prices.

The following are considered to be the market prices to-day:

	s. d.	s. d.	
Crude benzole	1 0	to 1 1	per gallon at works
Motor ,,	1 7	,, 1 8	,, ,, ,,
90 p.ct. ,,	1 9	,, 1 10	,, ,, ,,
Pure ,,	2 0	,, 2 1	,, ,, ,,

It was reported at a meeting of the Gas Committee of the Plymouth City Council on Thursday, March 28, that the output for the month of February showed an increase of over 14 p.ct. compared with the corresponding period of last year.

Three hundred and fifty ordinary shares in the Dawlish Gas and Coke Company, issued at £1 each, were sold by public auction at Dawlish on Friday, April 5. For the convenience of purchasers they were offered in lots of 50, and realized from 32s. to 33s. a share.



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COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

The market remains strong for prompt delivery, and colliery turns are mostly good for the remainder of the month. Continental competition is, however, beginning to make itself strongly felt again, and supplies are offering in considerably greater volume. For shipment beyond April coal is offered from this market at a good deal below current prices, but there is little business to be done.

Good prices are still obtainable for early shipment. Gas coals are firm at 16s. 6d. f.o.b. for Wear Specials, 15s. 6d. for best qualities, and 15s. to 15s. 6d. for seconds. Coking is still very scarce, and 15s. 9d. to 16s. 6d., according to quality, is the value for April shipment. Best Durham bunkers ask up to 17s. 6d., and ordinaries 16s. to 16s. 6d. Northumberlands are 16s. to 16s. 6d. for best screened sorts.

Gas coke is quiet, and is offered at 19s. to 19s. 6d. f.o.b. for shipment.

YORKSHIRE AND LANCASHIRE.

Although the pressure for supplies is not so great as it was before the Easter holidays, generally speaking collieries have sufficient orders to keep them employed for a considerable period. The forward inquiry, though not so keen, is still fairly brisk. On export account the production of best hards is not equal to the demand, and values for prompt business are maintained at 19s. 6d. to 20s. per ton.

The following are the Humber bunker and export prices, f.o.b. usual shipping ports:

South Yorkshire—Hards, Association, bunkers 21s., export 18s. to 18s. 6d.; screened gas coal, export 17s. 9d. to 18s. 3d.; washed trebles, export 18s.; washed doubles, bunkers 19s., export 16s. 9d. to 17s.; washed singles, export 16s. to 16s. 6d.; washed smalls, bunkers 15s., export 12s.; rough slack, bunkers 13s. 6d. to 13s. 9d., export 11s. to 11s. 6d.; smithy peas, export 18s. to 18s. 6d.

West Yorkshire—Hartley's (f.o.b. Goole), bunkers 17s. 6d., export 16s. 6d.; screened gas coal, export 17s. to 17s. 6d.; washed trebles, export 17s. 6d.; washed doubles, export 16s. 3d. to 16s. 6d.; washed singles, export 15s. 3d. to 15s. 6d.; washed smalls, bunkers 14s. 9d., export 11s. to 11s. 6d.; unwashed trebles, export 17s.; unwashed doubles, export 14s.; rough slack, bunkers 13s. 6d., export 9s. to 9s. 6d.; coking smalls, export 9s. to 9s. 6d.

Derbyshire and Nottinghamshire—Top hards, bunkers 20s. to 21s., export 18s. to 18s. 6d.; cobbles, export 17s. to 18s.; washed trebles, export 17s. to 17s. 6d.; washed doubles, export 16s. to 16s. 6d.; washed singles, export 15s. to 15s. 6d.; washed smalls, bunkers 14s. 9d. to 15s., export 11s. 6d.; unwashed doubles, export 14s. to 15s.; rough slack, bunkers 13s. 3d. to 13s. 9d., export 10s. to 11s.

Yorkshire, Derbyshire, and Nottinghamshire—Screened steam coal, bunkers 18s. to 18s. 6d., export 16s. to 17s.; gas coke, export 20s. to 22s. 6d.; furnace coke, export 20s. 6d. to 21s. 6d.; washed steam (Goole, West Yorkshire), bunkers 18s.; (Hull, West Yorkshire), bunkers 18s. 6d.; (Hull, South Yorkshire), bunkers 18s. 9d. to 19s., export 16s.

MIDLANDS.

There was no hurry to get back to work at the pits after Easter except in a few cases where high-grade household coals were wanted, or where the exigencies of the coke supplies necessitated special arrangements. With the output quota under the Five Counties control reduced to 67½, most of the collieries were able to take things quietly, and they did so.

Order books are being strengthened by the demand from public institutions, where it is sought to replenish stocks depleted by the abnormal consumption in the latter part of the winter. Electricity undertakings are also on the market for renewals.

The gas coal trade is uneventful. Contract deliveries generally are sufficient for requirements with the reduced consumption for heating and the approach of "Summer Time."

Collieries are anxious to find outlets for secondary qualities of domestic fuel. The market is sluggish, and a gradual easing of prices is apparent. With most of the works supplied with fuel for the resumption after the holidays, market conditions have been dull in that direction.

There have been more nuts and slacks on offer than could readily be absorbed, and the consequent slackening of values has amounted to about 6d. a ton.

No relaxation can be noted with regard to coke.

CONTRACTS OPEN.

Carbonizing Plant, &c.

The Municipal Gas-Works of Prague-Michle, Czechoslovakia, invite tenders for the supply of carbonizing and coke handling and screening plant, &c. [See advert. on p. 105.]

Coal.

The Ellesmere Port and Whitby Urban District Council invite tenders for gas nuts. [See advert. on p. 105.]

The Newbury Corporation invite tenders for Derbyshire and South Yorkshire gas nuts. [See advert. on p. 105.]

The Wellington (Salop) Gas Company invite tenders for the supply of gas nuts. [See advert. on p. 105.]

Pipes.

The Sidmouth Urban District Council Gas Department invite tenders for the supply of gas mains. [See advert. on p. 105.]

STOCK AND SHARE LIST.

[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.Yr	Dividends. Last Hf. Yr.	NAME.	Quotations. Apl. 2.	Rise or Fall on Week.	Transactions Lowest and Highest Prices.
£			%p.a	% p.a.				
171,978	Stk.	Feb. 7	5	5	Aldershot 5 p.c. max. C. .	70–75	..	..
412,992	,,	,,	4	4	Do. 4 p.c. Pref. . .	73–76	..	..
1,551,888	,,	Sept. 27	7	7½	Alliance & Dublin Ord. .	99–102	..	100
874,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb. . .	63–66	..	..
523,655	,,	Mar. 7	7	7	Barnet Ord. 7 p.c. . . .	112–115	..	..
800,000	1	Oct. 11	1/7½	1/4½	Bombay, Ltd.	20/–22/-	..	..
172,500	10	Mar. 7	8½	9	Bournemouth 5 p.c. . . .	12¾–13½	..	..
500,050	10	,,	7	7	Do. B 7 p.c. . .	12¾–12¾	+ ⅛	12⅛–12⅜
439,160	10	,,	6	6	Do. Pref. 6 p.c. .	10¾–11½	..	..
60,000	Stk.	Jan. 10	3	3	Do. 3 p.c. Deb. .	55–58	..	..
163,025	,,	,,	4	4	Do. 4 p.c. Deb. .	74–77	..	..
357,900	,,	Mar. 21	7½	7½	Brighton & Hove 6 p.c. Con.	113–116*	..	115
371,880	,,	,,	6½	6½	Do. 5 p.c. Con.	99–102*	..	..
1,337,500	,,	Feb. 21	5	5	Bristol 5 p.c. max. . . .	88½–89½a	..	..
885,000	,,	Sept. 27	7	8	British Ord.	118–121	..	119–120
100,000	,,	Dec. 20	7	7	Do. 7 p.c. Pref. . . .	115–120	..	..
130,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. .	73–76	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. .	93–96	..	94½–95
100,000	10	Dec. 6	8	8	Cape Town, Ltd. . . .	8–9	..	..
100,000	10	Oct. 25	4½	4½	Do. 4½ p.c. Pref. . .	6¼–7½	..	..
150,000	Stk.	Dec. 20	4½	4½	Do. 4½ p.c. Deb. . .	75–78	..	..
686,840	,,	Feb. 21	6	6	Cardiff Con. Ord. . . .	97–100	..	..
937,860	,,	Jan. 10	7½	7½	Do. 7½ p.c. Red. Deb. .	100–103	..	..
167,150	,,	Feb. 21	5	6½	Chester 5 p.c. Ord. . . .	87½–92½b	..	..
79,185	1	Oct. 11	1/2/-	1/2/-	Colombo Ltd. Ord. . . .	36/–38/-	..	..
34,495	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. . .	21/–23/-	..	..
875,402	1	Oct. 11	1/9½	1/9½	Colonial Gas Assn. Ld. Ord.	24/6–26/6	..	..
187,848	1	,,	1/7½	1/7½	Do. 8 p.c. Pref.	21/–23/-	..	..
2,078,280	Stk.	Feb. 21	5	7	Commercial Ord. . . .	98–101	..	98½
475,000	,,	Dec. 20	8	8	Do 3 p.c. Deb. .	56–59	..	..
600,000	,,	Sept. 27	11	11	Continental Union, Ltd. .	120–125	..	120–123
200,000	,,	,,	7	7	Do. 7 p.c. Pref. .	123–128	..	126½
137,560	,,	Feb. 21	7	7	Croydon sliding scale . .	110–113	+1	111–111½
468,100	,,	,,	5	5	Do. max. div. . . .	83–86	..	84–85
542,270	,,	Mar. 7	7	10	Derby Con.	112–117e	..	..
55,000	,,	Dec. 20	4	4	Do. Deb.	70–72e	..	..
200,000	,,	Mar. 7	5	5	East Hull Ord. 5 p.c. . .	73–76	..	..
1,902,180	10	Mar. 21	†4	†7	European, Ltd.	18½–20½*	–½	18⅞–19⅝
13,705,480	Stk.	Feb. 21	5½	5⅝	Gas Light & Coke 4 p.c. Ord.	18/9–19/3f	..	18/9–19/3
2,600,000	,,	,,	8½	8½	Do. 8½ p.c. max. . . .	63–65	..	65
4,157,020	,,	,,	4	4	Do. 4 p.c. Con. Pref. .	76–78	–½	76½–77
5,802,620	,,	Dec. 20	3	3	Do. 3 p.c. Con. Deb. .	58½–60½	..	59–60
3 642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. .	98–101	..	101½
82,500	,,	Mar. 21	7	7	Hastings & St L. 5 p.c. Conv	96–101*	..	..
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	77–82*	+1	..
10,000	10	Oct. 11	†10	†10	Hongkong & China, Ltd. .	13–14	..	..
213,200	Stk.	Mar. 7	5½	6	Hornsey Con. 3½ p.c. . .	86–89	..	..
1,975,000	,,	Nov. 8	10	10	Imperial Continental Cap.	390–410	+5	391–402
228,180	,,	Feb. 7	8½	8½	Do. 8½ p.c. Red. Deb.	69–72	..	..
235,242	,,	Mar. 7	7½	8	Lea Bridge 6 p.c. Ord. . .	117–120	..	..
3,145,907	,,	Feb. 21	5½	6½	Liverpool 5 p.c. Ord. . .	94½–95½b	+ ½	..
600,000	,,	Mar 21	7	7	Do. 7 p.c. Red. Pref.	100–102b	..	..
186,786	,,	Feb. 21	9	8	Maidstone 5 p.c. Cap. . .	124–129	..	128½–129
63,480	,,	Dec. 20	3	3	Do. 3 p.c. Deb. . .	54–57	..	..
75,000	5	Dec. 6	†8	†8	Malta & Mediterranean .	6½–6½	..	..
392,000	—	Apl. 2	—	5½	Metrop'l'tn (of Melbourne) 5½ p.c. Red. Deb. . . .	100–102*	..	..
941,920	Stk.	Nov. 22	†7	†5	Montevideo, Ltd. . . .	104–108	..	..
9,051,818	,,	Feb. 21	5	5⅜	Newcastle & Gateshead Con.	17/–17/9df	+·/1½	..
682,856	,,	,,	4	4	Do. 4 p.c. Pref. .	72⅝–73⅜d	..	..
691,705	,,	Dec. 20	8½	8½	Do. 8½ p.c. Deb. .	68½–69½d	..	..
181,780	,,	Mar 7	7/1/0	7/1/0	North Middlesex 6 p.c. Con.	105–110	..	..
800,000	,,	Nov. 22	7	9	Oriental, Ltd.	116–120	..	118
186,120	,,	Dec. 20	7½	8	Plym'th & Ston'house 5 p.c.	112–115	+4	..
424,416	,,	Feb. 21	7½	8½	Portsm'th Con. Stk. 4p.c. Std.	113–118	..	..
241,446	,,	,,	5	5	Do. 5 p.c. max.	81–84	..	..
1,334,464	1	—	—	—	Primitiva Ord.	30/–32/-	..	30/–30/9
244,500	100	Dec. 3	4	4	Do. 4 p.c. Red. Deb. . .	91–94	..	..
695,000	Stk.	Jan. 24	4	4	Do. 4 p.c. Red. Deb. 1911	78–80	..	..
416,345	,,	Dec. 20	4	4	Do. 4 p.c. Cons. Deb. . .	78–80	..	..
150,000	10	Mar. 21	6	6	San Paulo 6 p.c. Pref. . .	8½–8⅝*	..	..
1,736,968	Stk.	Mar. 21	6½	6⅝	Sheffield Cons.	106–108e	..	..
95,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb. . . .	74–77e	..	..
90,000	10	June 14	‡3	‡4	South African	4–6	..	..
9,009,895	Stk.	Feb. 21	6	7½	South Met. Ord.	104½–106½	–½	104½–106½
500,000	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	108–111	..	..
1,895,448	,,	Jan. 10	3	3	Do. 3 p.c. Deb. . .	58–60	..	..
734,060	,,	Mar. 7	6½	6½	Do. 6½ p.c. Red. Db.	99–101	..	..
91,500	,,	Mar. 7	8½	8½	South Shields Con. . . .	106½–107½d	..	..
1,543,795	,,	Feb. 21	6½	6½	South Suburban Ord. 5 p.c.	107–110	..	108½–110
468,837	,,	Dec. 20	5	5	Do. 5 p.c. Deb.	98–101	..	98
647,740	,,	Mar. 7	5	5	South'mpton Ord. 5 p.c. max.	76–78	..	..
131,275	,,	Dec. 20	4	4	Do. 4 p.c. Deb.	72–75	..	..
980,000	,,	Feb. 21	7	7	Swansea 7 p.c. Red. Pref. .	100–102	..	..
900,000	,,	Dec. 20	6½	6½	Do. 6½ p.c. Red. Deb.	100–102	..	101
1,004,275	,,	Mar. 7	—	6⅝	Tottenham District Ord. .	102–105	..	103–104½
180,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	95–98	..	..
181,255	,,	Dec. 6	4	4	Do. 4 p.c. Deb.	75–78	..	76
339,024	,,	Mar. 7	6⅞	7	Uxbridge, Maidenhead, & Wycombe 5 p.c. . . .	93–98	..	..
88,380	,,	,,	5	5	Do. 5 p.c. pref. .	85–90	..	..
80,000	,,	Feb. 21	8½	9	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c. .	147–152	..	..
956,536	,,	,,	7½	7½	Do. B 5½ p.c. .	125–130	..	..
422,585	,,	,,	6⅝	6⅝	Do. C and New	102–107	..	..
863,000	,,	,,	7½	7½	Do. Wimbledon 5 p.c. .	115–120	..	..
98,000	,,	,,	7½	7½	Do. Epsom 5 p.c. . .	126–131	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Pref . . .	90–95	..	..
88,416	,,	Dec. 20	3	3	Do. 3 p.c. Deb. . . .	56–59	..	..
384,748	,,	,,	4	4	Do. 4 p.c. Deb. . . .	77–80	..	..
397,500	,,	,,	5	5	Do. 5 p.c. Deb. . . .	97–100	..	..

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Manager.

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Lowestoft.

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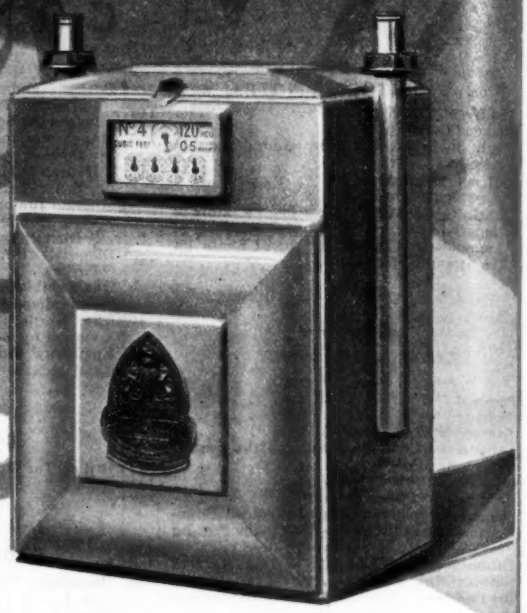

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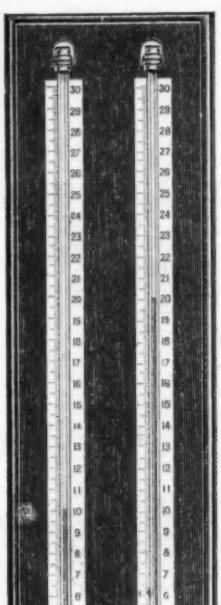

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